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MARGE TÄKS

Engineering students' experiences of entrepreneurship education

A qualitative approach

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II Täks, M., Tynjälä, P., & Kukemelk, H. (2015). Engineering students' conceptions of entrepreneurial learning as part of their education. *European Journal of Engineering Education,* (Published online on February 14th), doi: 10.1080/03043797.2015.1012708

III Arpiainen, R.-L., Lackéus, M., Täks, M., & Tynjälä, P. (2013). The sources and dynamics of emotions in entrepreneurship education learning process. *Trames: Journal of the Humanities and Social Sciences, 17*(4), 331–346. doi: 10.3176/tr.2013.4.02

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Article I: Designing the study, formulating the research questions, carrying out the data collection and analysis, and writing the paper as the main author.

Article II: Designing the study, formulating the research questions, carrying out the data collection and analysis, and writing the paper as the main author.

Article III: Participating in the creation of the study design, determining the instruments for the study, carrying out the Estonian data collection and participating in the analytical process, participating in the formulation of the research questions, leading the writing process in shared authorship.

1. INTRODUCTION

Rapidly changing world and technological developments place high demands on future employees, who are expected to possess diverse generic skills and to be innovative. Engineers are no exception. Labour markets are not as stable as a decade ago and engineers within companies are expected to be entrepreneurially minded as well as to create new jobs. New generations of engineers need deep knowledge in their field as well as the ability to work and communicate across disciplinary boundaries in solving complex problems. Meeting the social, economic and environmental challenges of professional engineering activities means that engineers also have to understand how the markets work and what it means to create value for the customer, while adhering to ethical standards (Duval-Couetil, Reed-Roads, & Haghighi, 2012). Thus, developing the capability to take effective and appropriate actions in unfamiliar and constantly changing circumstances in the workplace is needed (Barnett, 2004; National Academy of Engineering, 2005; Stephenson, 1992; Tynjälä & Gijbels, 2012).

The development of this kind of professional *expertise* in a specific domain requires acquiring deep knowledge of key concepts, the ability to apply this knowledge to solve complex and novel problems, the ability to critically reflect on one's own activities, and, finally, to acquire self-regulative and lifelong learning skills (Jamieson & Lohmann, 2009; Rugacia, Felder, Woods, & Stice, 2000; Tynjälä, 2008; Tynjälä & Gijbels, 2012; etc.). Long-term engagement, deliberate practice and working in one's chosen field are prerequisites for developing this kind of expertise (Boshuizen, 2009; Eraut, 2004; Ericsson, 2006; Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson, Prietula, & Cokely, 2007; Litzinger, Lattuca, Hadgraft, & Newtetter, 2011; National Academy of Engineering, 2005; Rugacia et al., 2000; Tynjälä & Gijbels, 2012). Before solving problems, one has to learn to also see the opportunities in problems, i.e., recognise problems as an opportunity for innovation, in order to develop solutions within an increasingly diverse community (Brown, 2000; Byers, Dorf, & Nelson, 2010; Jamieson, & Lohmann, 2009; National Academy of Engineering, 2005; Rae, 2003; Rugacia et al., 2000). In addition, excellent communication and team-working skills in collaboration across disciplines is necessary to connect ideas from different interdisciplinary systems (Creed, Suuberg, & Crawford, 2002; Litzinger et al., 2011; National Academy of Engineering, 2005; Rugacia et al., 2000; Sawyer, 2007; Tynjälä & Gijbels, 2012).

Since entrepreneurship education addresses many of the skills so crucial to future engineers, it is often seen as an opportunity within engineering education. Many reports suggest that in order to overcome the aforementioned challenges, integrating entrepreneurship education into scientific and technical studies and within technical institutions is necessary (European Commission, 2006, 2008; Jamieson & Lohmann, 2009; National Agency of Engineering, 2005; European Society for Engineering Education (SEFI), 2011; and others). According to the scholars in the field of entrepreneurship education, entrepreneurial learning

should be experiential in nature, active and focus on opportunity pursuit, opportunity evaluation and commercialising ideas (Cope, 2003; Fayolle & Gailly, 2008; Gibb, 2002, 2008; Pittaway & Cope, 2007; Lans, Oganisjana, Täks, & Popov, 2013; Porter, 1994; Rae, 2003). In addition, it should provide valuable learning experiences for learners to develop their imagination, creativity and innovativeness, as well as their risk-taking/management and networking skills (Cope, 2003; Cooper, Bottomley, & Gordon, 2004; Gibb, 2002, 2008; Jones & English, 2004; Kyrö, 2005; etc.) and their ability to be effective (European Commission, 2008; National Agency of Engineering, 2005; Sawyer, 2007). It is seen as just as important to also learn to become resilient to failures and to possess determination for achieving set aims (Shepherd, 2004).

Even though it is widely recognised and accepted that entrepreneurship education can be seen as an opportunity for modernising education and for meeting future labour market demands, research work on the factors that affect the underlying learning processes remains rare (Lans et al., 2013). Finding research that highlights the application of entrepreneurship education within engineering education is even more challenging. Also, the extent, the nature and outcomes of provided entrepreneurship programmes have not been thoroughly explored in scientific literature (Duval-Couetil et al., 2012; Duval-Couetil, 2013). Standish-Kuon and Rice (2002) complement this argument, adding that a clear understanding of what entrepreneurship education within the engineering context should be is needed and should be supported by scientific evidence. For example, in Estonia no scientific evidence of this kind can be identified. In addition, the research conducted and presented in existing literature seems to mostly relate to elective entrepreneurship courses and programmes, whereas studies on compulsory entrepreneurship courses are very scarce.

1.1. The latest developments and challenges in engineering education

With the aim to enhance student learning, engineering education has been developed by taking into account scientific advancements and technological developments. In addition, Litzinger and colleagues (2011) highlight the pedagogical changes being made, such as the application of team-based and "authentic" project-driven activities, to deepen students' deep conceptual knowledge and professional expertise. Even though the changes that have occurred have been positive, many reports on engineering education state that the initiatives undertaken still do not adequately prepare students to meet the challenges of the 21st century's labour market. Several research reports highlight that engineering curricula are tightly sequenced, highly technical, based on the traditional models, imbalanced when it comes to theory and practice, and do not sufficiently take into account how people learn (Creed et al., 2002; Jamieson & Lohmann, 2009; Kriewall & Mekemson, 2010). Multi-cultural experiences

and cross-disciplinary educational experiences are rarely exercised (Jamieson & Lohmann, 2009; Creed et al., 2009). Most of this also seems to be the case in Estonia. In the United States, reports by both the American Society for Engineering Education (ASEE) (2009) and the National Academy of Engineering (NAE) (2005) call for "re-engineering the engineering education" in order to address the demands faced by future engineers. Kriewall and Mekemson (2010) highlight the importance of entrepreneurially minded engineers who should be key influencers in creating new products. In Europe, the European Commission Expert Group's (EG) *Final Report 2008* to the European Commission (EC) and the *Annual Report 2011* of the European Society for Engineering Education (SEFI) drew special attention to the challenges related to developing technical and science curricula and to the need for universities to increase their teaching of entrepreneurship and become more entrepreneurial.

1.2. Entrepreneurship education in technical and engineering studies

The *Communication 2006* from the European Commission (EC) to the Council and the Expert Group's (EG) *Final Report 2008* to the European Commission (EC) highlight that entrepreneurship is not yet adequately integrated in higher education curricula. The general situation regarding entrepreneurship education is considered weak by the experts, especially in non-business and technical fields of study where mainly accounting and innovation courses are offered to the students (European Commission, 2008). In addition, the quality of those courses seems to be questionable, since academic staff do not have sufficient experience and qualifications (EC, 2008, p. 16; EC, 2011). The same report suggests that higher education institutions (HEI) should develop entrepreneurial mindsets and graduates who are creative and flexible problem solvers able to cope with uncertainties (EC, 2008, p. 9). Further, the report suggests that policy makers should initiate the legislation, accreditation and award systems for universities, and that at the HEI-level, strategies and action plans, incentive systems, and the awarding of academic credits should be implemented. This also means developing and implementing new learning and teaching methods, developing and delivering new innovative study programmes, organising continuing educational programmes and activities with and within companies, applying entrepreneurship education to any discipline, conducting field-related activities that are embedded in curricula, and developing students, researchers, teachers and company staff, as well as other initiatives (European Commission, 2008, p. 9). Also, general business and economic studies should not be confused with entrepreneurship education, since the goals of the former and latter differ: while business studies emphasise economic theories, entrepreneurship education promotes creativity, innovation and self-employment (EC, 2008, p. 10).

As mentioned before, Estonian engineering education seems to face the same situation as the United States and the EU countries when it comes to curricular challenges. For example, curricula seem to be rather technical, concentrating on teaching concepts and theories, not necessarily on putting learned concepts and theories into practice. Also, in Estonia, there are few elective courses to choose from and the learning environments provided offer mainly traditional learning. For example, a survey that is conducted among higher education alumni of the University of Tartu (UT) (2011) in Estonia brought out the shortage of practice-based learning. The lowest scores related to the development of skills in leadership, self-establishment, argumentation and negotiation, and to foreign language proficiency (UT, 2011). Team-working skills, although a category that received higher scores than the aforementioned skill areas, also did not meet labour market needs in the opinion of most alumni. The research team concluded that universities contribute little to the development of skill sets that prepare students for their future work life. In a recent Estonian study by Vadi, Reino and Aidla (2014) on students and teachers, regarding their perceived roles and expectations of each other, half of the participants expressed the importance of emotional connectedness between the students and the teacher. The participating students also felt that teachers should raise students' interest in their subject, consider learners' personal progress, highlight learners' potential, and treat each student as equal. In the students' view, teachers should activate them during lectures, promote/initiate discussions in order to make them think critically, direct them to analyse discussed issues, and provide a supportive and positive learning environment.

Jamieson and Lohmann (2009) support these statements by claiming that experiential learning experiences in engineering education should not be underestimated, and suggested that the educational institutions' faculties should develop programmes together with business schools. Similarly, Bilén, Kisenwether, Rzasa and Wise (2005) have suggested introducing more entrepreneurship programmes and/or competitions in order to introduce the topics of business formation, intellectual property, business finance and marketing to engineering students. Jamieson and Lohmann (2009) added that increasing the engineering knowledge base and learning through entrepreneurship would help engineering students to assess their learning in reference to entrepreneurship; and, moreover, it would help students to critically evaluate and consciously develop skills that are needed to survive and be successful in their future careers. It has also been emphasised that entrepreneurship education within engineering education should be seen as a way to enhance creativity and innovation, in addition to helping students to recognise opportunities over problems, and that this would ideally lead to identifying potential technology-oriented commercial opportunities (Byers et al., 2010).

The purpose of this dissertation was to acquire a thorough understanding of engineering students' experiences of compulsory entrepreneurship education. Thus, entrepreneurship education within engineering study programmes was

investigated from students' perspectives. Based on the research findings, how teaching and learning practices can be improved is also discussed.

In Chapter 2, as follows, entrepreneurship education is described in more detail to share the ideas that have driven this research. Chapter 3 presents the origins of this study and its purpose, while Chapter 4 introduces the methodology that was used to conduct the research. In the Methodology chapter, a closer look is taken at the concept of phenomenographic research. A strong argument for using this approach is the current lack of phenomenographic research in Estonia. The results of the study are presented in Chapter 5, and in Chapter 6 those results will be discussed together with the contributions and limitations of the study.

2. ENTREPRENEURHIP EDUCATION: WHAT AND HOW?

Establishing argumentation for the need to offer entrepreneurship education and/or ideally integrate it into engineering education calls for an explanation of what this actually means. There is neither unified understanding nor one right definition of what entrepreneurship education is, but many interpretations exist that vary depending on its purpose, extent and environment. For example, the *UK Enterprise and Entrepreneurship Education Report 2012* by the Quality Assurance Agency for Higher Education (QAA) as well as the Expert Group's (EG) *Final Report 2008* to the European Commission (EC) state that entrepreneurship education is about providing alternative career options, developing enterprise skills, instilling courage (for risk-taking), and developing the ability to act entrepreneurially based on learning about and experiencing enterprise. Entrepreneurship education can be embedded in curricula or offered as an elective course, or it can be provided by career service providers, business incubators and other relevant entities. The Expert Group's (EG) *Final Report 2008* to the European Commission (EC) offers the following definition of entrepreneurship education:

"Entrepreneurship refers to individuals' ability to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. This supports everyone in day-to-day life at home and society, makes employees more aware of the context of their work and better able to seize opportunities, and provides a foundation for entrepreneurs establishing a social or commercial activity." (European Commission, 2008, p. 10)

While the EU definition of entrepreneurship education is largely outcome-oriented, Gibb's (2008) definition manages to also address the entrepreneurial learning process. He states that entrepreneurship/enterprise, in an educational context, is:

"Behaviours, skills and attributes applied individually and/or collectively to help individuals and organisations of all kinds to create, cope with and enjoy change and innovation involving higher levels of uncertainty and complexity as a means of achieving personal fulfilment and organisational effectiveness. Enterprise education is the process by which these behaviours are practised and supported." (Gibb, 2008, p. 106)

Thus, entrepreneurial learning is about developing the ability to manage unexpectedly occurring events and to create new and novel ideas in a freely chosen way: it is about freedom, not about a structured process (Jones, 2011). Rae (2005) compliments this by stating that entrepreneurial learning means to "recognise and act on opportunities, and interacting socially to initiate, organise and manage ventures" (p. 324). Thus, it is also not about acquiring and knowing all the right answers, sticking to "the way things have always been done" or reproducing facts, but rather about learning to function successfully "outside the

comfort zone" and becoming comfortable with this state of mind, and even being inspired by it. Pittaway and Cope (2007), Fayolle and Gailly (2008), and many others support this argument by elaborating that entrepreneurial learning is action-oriented, stimulating (creating and experimenting with ideas, and failing and learning from mistakes), highly emotional, and about overcoming challenges (solving problems). Rae (2003) also describes phases of the process of opportunity-centred entrepreneurial learning that are equally important: 1) identifying and exploring the opportunity; 2) relating the opportunity to personal goals; 3) planning to realise the opportunity; and 4) acting to make things happen (p. 545). In this context, developing an entrepreneurial mindset can be considered as the orientation toward entrepreneurial activities, where a person is able to deal with uncertainty, constant changes, and is seeking innovation (Rae, 2003). In sum, there seems to be a consensus that entrepreneurial learning should involve the identification of opportunities, creative problem solving, negotiation skills, strategic and critical thinking, networking, risk-managing, intuitive decision making, managing business situations holistically, coping with failure, being effective, and knowing your markets and clients, etc. (Fayolle & Gailly, 2008; Gibb, 2008; Pittaway & Cope, 2007; Pittaway & Thorpe, 2012; Rae, 2003, 2005; etc.).

2.1. The theoretical basis of entrepreneurship education

Several learning theories are used in entrepreneurial learning within and outside the educational context, such as the *action learning theory* (e.g., Revans, 1981, 2011), *experiential learning theory* (e.g., Kolb, 1984; Kolb & Kolb, 2005), and *socio-constructivist learning theory* (e.g., Palincsar, 1998; Tynjälä, Pirhonen, Vartiainen, & Helle, 2009).

The *action learning theory* has been widely used in management training and its focus is on behavioural changes that occur in managers when they try to solve problems related to their organisation (Revans, 1981, 2011). Kayes (2002) states that the main aim of action learning is to improve the effectiveness of managerial behaviours in order to improve management and goal-directed outcomes. He adds that to discover and anticipate mistakes and effectively communicate information leads to achieving set goals. Originating from the field of adult action learning, this theory has been adjusted and also applied in educational settings, particularly in adult learning and training.

The *experiential learning theory,* in turn, focuses on learners acquiring and transforming through new experiences, and emphasises satisfaction, motivation and development (Heron, 1992; Kolb, 1984, etc.). Kayes (2002) presents an overview of the approach, explaining its origins and, in essence, stating that experiential learning (as well as management learning) helps managers to develop a more holistic view of themselves through new experiences, and is

characterised by treating the manager as a person (i.e., a better person will also be a better manager) rather than solely as an instrument for achieving goals. Kolb's (1984) well-known theory presents experiential learning as a cycle involving four concrete dimensions, namely, abstract conceptualisation, active experimentation, concrete experience, and reflective observation. Kayes (2002) sees the experiential learning theory as the integration of several epistemologies (Dewey's pragmatism, Lewin's social psychology, Piaget's cognitive development, Roger's client-centred therapy, Maslow's humanism, and Perls' Gestalt therapy) into a single framework. This has also been the source of some criticism directed toward the experiential learning theory. For example, Freedman and Stumpf (1980) have raised questions about empirical evidence regarding Kolb's preceding *learning style theory,* arguing that even though the theory is applied widely, its empirical evidence is based on "a single piece of unpublished research" and used an unreliable, biased instrument designed to support the theory (p. 446–447). Miettinen (2000) has questioned this problematic interpretation of the concept of experience and reflective thought (p. 70), arguing that if an experience is problematic then so might be reflecting on the experience. Miettinen (2000) also concerned himself with the process of 'how' in experiential learning, that is, how experience, perception, cognition and behaviour are combined in experiential learning theory.

The *socio-constructivist learning theory* draws on Piaget's idea of socio-cognitive conflict on one hand, and on Vygotsky's socio-cultural approach (Palincsar, 1998; Vygotsky, 1978) on the other. Common to different socio-constructivist approaches is that learning is considered to happen through social interaction, negotiation and collaboration, and learning processes are seen to be context-dependent, and they consider the heterogeneous nature of today's learners (Palincsar, 1998; Tynjälä et al., 2009). Since the socio-constructive approach has been widely applied with rigour in educational settings, it offers a promising evidence-based framework and tools for its implementation as well as solid scientific proof.

Even though the highlighted theories use different conceptual frameworks and philosophical foundations, they all share common features and have similar pedagogical implications. For example, they emphasise metacognitive and self-regulative processes of learning. Similarly, they all focus on active learning by doing, on constant and creative problem solving and teamwork, and on interaction with the real world. They all aim to integrate theoretical and practical knowledge and to enhance critical thinking as well as promoting reflection in order to make learning explicit. Finally, they all see the teacher's role differently from traditional learning theories. The teacher is seen as a co-learner, role model, tutor, and facilitator of learning rather than simply as a transmitter of knowledge (EC, 2008, 2011; Gibb, 2008; Kyrö, 2005; QAA, 2012; Tynjälä et al., 2009).

The basis for the specially developed entrepreneurship course examined here is the socio-constructivist learning theory. The rationale for choosing the socio-

constructivist learning theory as the basis is the extent to which it has been used in recent educational research and its reliability having been empirically proven. The socio-constructivist learning theory is a dominant approach in educational research. The integrative pedagogy model that is used as a framework for teaching and learning was selected since it originates from the socio-constructivist learning theory. Furthermore, the integrative pedagogy model has been developed further through other studies of professional expertise (e.g., Bereiter & Scardamalia, 1993, 2003; Boshuizen, 2009; Eraut, 2004; Ericsson, 2006; Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson, Prietula, & Cokely, 2007). The main principle of integrative pedagogy is to integrate the basic elements of professional expertise, that is, theoretical/conceptual knowledge, practical/experiential skills and knowledge, self-regulation skills and socio-cultural knowledge, with each other. A detailed description of the modifications made to the integrative pedagogy model for the specially designed entrepreneurship course and a basic course description can be found in Article I, and an additional, broader course description is given in Article II. The strength of the integrative pedagogy model lies in its clear structure and its useful set of tools when it comes to applying socio-constructivist principles to the practice of teaching and learning. Moreover, its recent theoretical developments (Tynjälä, 2015) also consider the emotional dimension of learning, which has recently received increased attention in learning research (Pekrun & Linnenbrink-Garcia, 2014; Fiedler & Beier, 2014; Carver & Scheier, 2014; Graham & Taylor, 2014; Pekrun & Perry, 2014; Linnenbrink-Garcia & Barger, 2014; Schultheiss & Köllner, 2014; Skinner, Pitzer, & Brule, 2014; Brackett & Rivers, 2014; etc.). Other aspects that are more explicitly exhibited in the new integrative pedagogy model when compared to its previous version (see also Article I) are the social context of learning and the cognitive dimension of learning. All of the considered levels – emotional, social, and cognitive – are closely interrelated/ interwined.

Integrative pedagogy is illustrated in more detail in Figure 1 and in Article I. Detailed descriptions of problem-solving tasks and examples on how the entrepreneurship course was designed can be found in Article I.

In line with recent studies on emotions in learning (e.g., Pekrun & Linnenbrink-Garcia, 2014; Fiedler & Beier, 2014; Carver & Scheier, 2014; Graham & Taylor, 2014; Pekrun & Perry, 2014; Linnenbrink-Garcia & Barger, 2014; Schultheiss & Köllner, 2014; Skinner et al., 2014; Brackett & Rivers, 2014; etc.), entrepreneurship education scholars have emphasised the presence of high levels of emotions in the entrepreneurial learning process (e.g., Cope, 2003, 2005; Gibb, 2002, 2010; Kyrö, 2005, 2008; Pittaway & Cope, 2007; Pittaway & Thorpe, 2012; etc.). The role of emotions in entrepreneurial learning is seldom investigated. The same scholars have stated that it is crucial for the learner to reach the affective state that is necessary for developing self-efficacy (see Bandura, 1994), resilience (Shepherd, 2004) and effectuation of learning (see Sarasvathy, 2001). These points formed the rationale behind writing Article III.

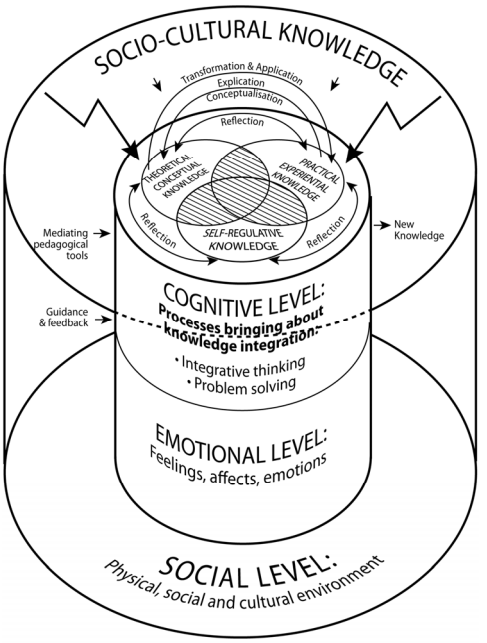

Figure 1. Integrative pedagogy model (Modified from Tynjälä, 2015).

3. THE STARTING POINT AND PURPOSE OF THE STUDY

3.1. The starting point of the study

The current study was conducted in connection with an obligatory entrepreneurship course for engineering students at the TTK University of Applied Sciences in Estonia. It was specifically developed to suit engineering study programmes within higher education. The developed entrepreneurship course was the result of a larger development programme initiated by the Ministry of Economics and Communication and the Ministry of Education and Research in Estonia in cooperation with universities, and was funded by the Archimedes Foundation project Primus. The entrepreneurship course specifically aimed at improving curricula and teaching practices, with a special focus on enhancing entrepreneurial mindsets and entrepreneurial competencies. As a result, an entrepreneurship course suitable for integration into any engineering curriculum in modern higher education was developed.

The pilot study to investigate the newly developed entrepreneurship course for engineering students took place in the academic year 2009–2010. During the pilot, considerable changes in teaching practices were applied. It was soon noticed that changes in teaching practices led to changes in engineering students' learning. The new dynamics and reactions were difficult to explain by teachers who experimented with applying the new pedagogical methods for the first time. As a result of the pilot, the course outcomes, such as company portfolios, presentations, memos and students' feedback illustrated considerable improvements compared to the courses from previous years. However, the new learning dynamics that appeared in the classroom during the pilot left many questions about students' learning experiences unanswered. On the one hand, it was evident that students' reports on the projects had improved, but, on the other hand, how the learning actually took place and what kinds of different aspects of learning students discerned was not quite clear. Consequently, the decision to conduct additional research on the students' perspectives on their entrepreneurial learning experience was born. This was important in order to assess whether the developments actually led students to a more powerful understanding of entrepreneurial issues. In order to make future improvements, it was necessary to understand how the learning took place and what kinds of learning can be discerned. After detailed planning, the new study introduced in this dissertation began. The research data were collected over a period of four months (September–December, 2010), examining the compulsory entrepreneurship course offered as part of a higher education programme in engineering.

During the dissertational study, two of the university teachers (including the author of this dissertation) that were involved in teaching the course had also been responsible for its earlier development (the preceding pilot). After the pilot, some changes were made to the course structure. In addition, the integrative

pedagogy model was introduced as a framework. During the both of the teachers kept research diaries and discussed their observations as frequently as needed (on a weekly basis, and sometimes more frequently). During the course, based on those teacher discussions and observations, some changes were made to the instructional strategy and reflection tools.

Since the pilot course in 2009–2010, teaching practices were changed by around 70%. Another aim of keeping research diaries was to be able to reflect on teachers' feelings and understanding of the new dynamics that appeared in the classroom during the tutorials. Both of the teachers/ researchers were also responsible for conducting the group and individual interviews referred to in this study. The most difficult part of the study was to step out of the role of being the teacher and into that of the researcher, which is the reason why two additional researchers were involved in the analytic process later on.

3.2. The purpose of the study

The overall purpose on this study was to acquire a thorough understanding of engineering students' experiences of compulsory entrepreneurship education.

The main research question was formulated as follows:

How do engineering students experience entrepreneurship education as a compulsory part of their education?

This overarching research question was studied from three different perspectives, explored through the following sub-questions:

1) How do engineering students experience studying entrepreneurship as part of their study programme?
2) What kinds of conceptions of entrepreneurial learning do engineering students express in the entrepreneurship course?
3) What are the sources of negative and positive emotions in entrepreneurship education?
4) What kinds of dynamic patterns of emotional aspects can be identified in the engineering students studying entrepreneurship?

4. METHODOLOGY

This chapter will firstly describe the three entrepreneurship courses that were the object of this study. Secondly, a short overview of the study's research methods, phenomenography (Articles I and II) and thematic analysis (Article III) will be provided. In concluding the chapter, the data collection methods, interviewing principles and data analysis will be described.

4.1. Studied courses

The present study on entrepreneurship education was conducted regarding three different cultural contexts. In Articles I and II, an entrepreneurship course for engineering students in Estonia was examined, and in Article III Estonian data were combined with Finnish and Namibian entrepreneurship programme data to investigate emotional dimensions in entrepreneurial learning. Although all three courses were dealing with entrepreneurial learning and their aims were similar, the length of the courses and the background of the students differed considerably. The Estonian course applied socio-constructivist learning principles and integrative pedagogy as a basis, whereas both the Finnish and Namibian study programmes applied action learning principles (which are nevertheless in line with socio-constructivism and integrative pedagogy). The Estonian course was compulsory, but in Finland and Namibia the students applied for the programme on a voluntary basis. The Estonian course lasted 4 months, the Finnish one 2.5 years, and the Namibian one 2 years.

4.1.1. The Estonian entrepreneurship course

The Estonian course was designed according to the socio-constructivist view of learning and its pedagogical design was based on the integrative pedagogy model (Täks, Tynjälä, Toding, Kukemelk, & Venesaar, 2014; Tynjälä, 2008, Tynjälä & Gijbels, 2012).

This entrepreneurship course took place on a weekly basis, and the students had specific tasks (problems to solve) for each week. The course started with student teams being requested to generate their own business ideas. After choosing their strongest idea, each team started to build on their idea by investigating and evaluating the relevant marketplace, investment possibilities, financial opportunities and so on, based on which to form an initial business plan.

All tasks presented to the teams were related to each other. For example, the task for each subsequent week departed from the task of each previous week. At the beginning of each week's tutorial, the students had to present their solutions to the problems that had been reported at the end of previous week's tutorial. Teaching methods based on the principles of progressive problem solving (e.g.,

Bereiter & Scardamalia, 1993, 2003; Pittaway & Thorpe, 2012), project learning (e.g., Tynjälä et al., 2009), and active experiential learning were applied. During each tutorial, the results of each group were discussed. Then, new challenges were introduced together with preparations for tackling these challenges, such as verbal guidance, book chapter references and so forth. Problem solving was used as a tool for learning, and reflection and feedback for allowing students to develop critical thinking and to raise self-awareness. In conjunction with the group tasks, some role plays as well as self-evaluation and personal development tasks, among others, were presented. For example, the students were asked to analyse their presentation and team skills. At the end of the course, the teams had to present the business portfolio of their hypothetical company and defend their business plan. Portfolios consisted of legal documents, job descriptions for the selected virtual job positions and responsibilities, self-evaluations, selections of weekly tasks (e.g., market and consumer research results as well as business plans). In general, the process of the course itself followed the start-up process of the teams' hypothetical companies.

The entrepreneurship course was worth 6 credit points. All of the graduates who participated in the course as part of their higher education would go on to acquire a higher engineering certificate with 240 credit points as a result of their four years of study.

4.1.2. The Finnish and Namibian entrepreneurship courses

The learning process in Finland and Namibia involved action learning principles and was supported by coaches. The students had to set up a virtual, sustainable corporate concept in teams and integrate their learning needs to support the team development. The Namibian entrepreneurship programme called *Prolearning* was based on the model of the Finnish entrepreneurship programme called *Proacademy,* so the basic principles for learning in Finland and Namibia were similar.

In the Proacademy and Prolearning programmes, the team plays the central role in the pedagogical studies and the learning process. The action is based on working and learning together, where the latest theoretical knowledge is applied and new knowledge generated. In addition to real-world projects, the course studies consist of team meetings, small group workshops and coaching. The teams learn and projects grow through continuous feedback. In the weekly team sessions, the students learn by giving and getting both positive and negative feedback.

The Finnish students were enrolled in a 3.5-year Bachelor programme of which they spent 2.5 years in the Proacademy programme. The Namibian students were studying for a five-year Honours degree and spent the last two years of this time in the Prolearning programme.

Both in Finland and Namibia, students had to apply for the entrepreneurship programme and their selection was made based on individual interviews.

4.2. A general overview of phenomenography

Two of the three studies comprising this dissertation were conducted with a phenomenographic research approach. Phenomenography is empirical and pragmatic research that aims to examine qualitatively different ways in which people experience or understand something. Phenomenography has been developed within the educational research framework with a pedagogical orientation (Marton, 1981, 1986; Marton & Booth, 1997; Marton & Svensson, 1979; Trigwell, 2006; etc.).

The word *phenomenography* is thought to have Greek etymological roots, deriving from the words *phainonmenon* (appearance) and *graphein* (description). Thus, the word phenomenography can be interpreted as 'a description of appearances' (Hasselgren & Beach, 1997). The most cited definition of phenomenography states that:

"Phenomenography is a research method adapted for mapping the qualitatively different ways in which people experience, conceptualise, perceive and understand various aspects of, and phenomena in, the world around them." (Marton, 1986, p. 31)

When Marton first introduced phenomenography in 1981, he described it as being content-oriented and aiming at forming an experiential description of "the qualitatively different ways in which people perceive and understand their reality" (p. 177). An important characteristic of phenomenography is that it aims to describe, analyse and understand experiences from "people's own perspective" (Marton, 1981). In other words, people's experiences or conceptions of different phenomena of the world are the focus of study. In order to highlight the philosophical and methodological fundamentals of phenomenography in more detail, the aspects typical to phenomenography are presented in Table 1. In sum, there are five main characteristics of phenomenography: its 1) non-dualist and 2) qualitative nature, 3) second-order perspective, 4) focus on the key aspects of variation, and 5) outcome in the form of internally related categories.

The research orientation described above is sometimes also referred as "pure" phenomenography. More recently, Bowden (2000) has introduced a phenomenographic orientation that is called "developmental" phenomenography, which aims to seek out "how people experience some aspects of their world and enable them or others to change the way their world operates" (p. 3). The difference between these two approaches, *pure* and *developmental,* lies in how the findings are used. While pure phenomenography describes the variation in individuals' understandings or experiences, the main aim of developmental phenomenography is to provide findings that can later be used in teaching and learning (Bowden, 2000). The phenomenographic research that has been conducted in connection with this dissertation has aimed to take the developmental approach and to provide findings that can be used as an input to improve learning experiences and teaching practices, and to contribute to curricular developments in engineering education and to entrepreneurial learning.

Table 1. *Philosophy, Method and Outcome of Phenomenography.* (Compiled based on: Åkerlind, 2005a, 2012; Bowden, 2000; Collier-Reed & Ingerman, 2013; Marton, 1981, 1986, 1995; Marton & Booth, 1997; Tan, 2009; Trigwell, 2006, etc.)

Philosophy	1) Non-dualist	Phenomenography is a *non-dualist* approach, where experience and understanding are seen as the *relationship between the individual and the phenomenon* (Marton, 1981, 1986, 1995; Trigwell, 2006). A non-dualist philosophy sees individuals and phenomena as being inseparable (Tan, 2009)
Method	2) Qualitative	Phenomenography is a philosophically and methodologically qualitative research method, seeking qualitative differences in individuals' experiences and understanding (Trigwell, 2006). In-depth interviews are the most common form of data used in phenomenographic studies, and samples are selected to maximise the possible variations (Åkerlind, 2005a, 2012; Bowden, 2000; Marton, 1986; Marton & Booth, 1997)
	3) Second-order perspective	Phenomenography adopts a second-order perspective. In a second-order perspective, the researcher makes statements about individuals' experiences and ideas regarding the world rather than about the phenomenon itself (Marton, 1981, 1986, 1995; Tan, 2009; Trigwell, 2006)
	4) Focus on key aspects of variation	The focus is on key aspects of the variation in experience (Marton, Booth, 1997; Trigwell, 2006). The aim is to find out how individuals' experiences or conceptions vary and what the aspects that differentiate different experiences or conceptions are.
Outcome	5) Internally related categories	Limited number of hierarchical, qualitatively different and internally related categories form the "outcome space" representing different ways of experiencing a phenomenon (Åkerlind, 2012; Collier-Reed & Ingerman, 2013; Marton, 1981, 1986; Marton & Booth, 1997)

4.2.1. The object of phenomenographic study

In phenomenography, the focus of research is not the phenomenon per se, but rather the relation between the subject and the phenomenon, that is, how the student, teacher or other type of individual understands the phenomenon (Åkerlind, 2005a, 2012; Barnard, McCosker, & Gerber, 1999; Bowden, 2005; Collier-Reed & Ingerman, 2013; Marton, 1981, 1986, 1995; Marton & Booth, 1997; Svensson, 1997, etc.). This is illustrated in Figure 2. For example, in Article I of this dissertation, the object of the study was engineering students' (the subjects) experiences of studying entrepreneurship (the phenomenon) as part of their study programme (the context); and in Article II, it was engineering

students' (the subjects) conceptions of entrepreneurial learning (the phenomenon) as part of their education (the context).

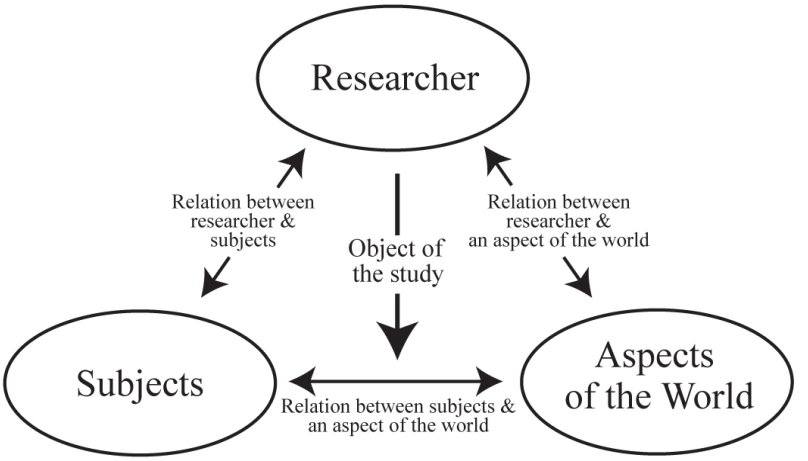

Figure 2. Focus of phenomenographic research (based on Bowden, 2005, Figure 1.1, p. 13).

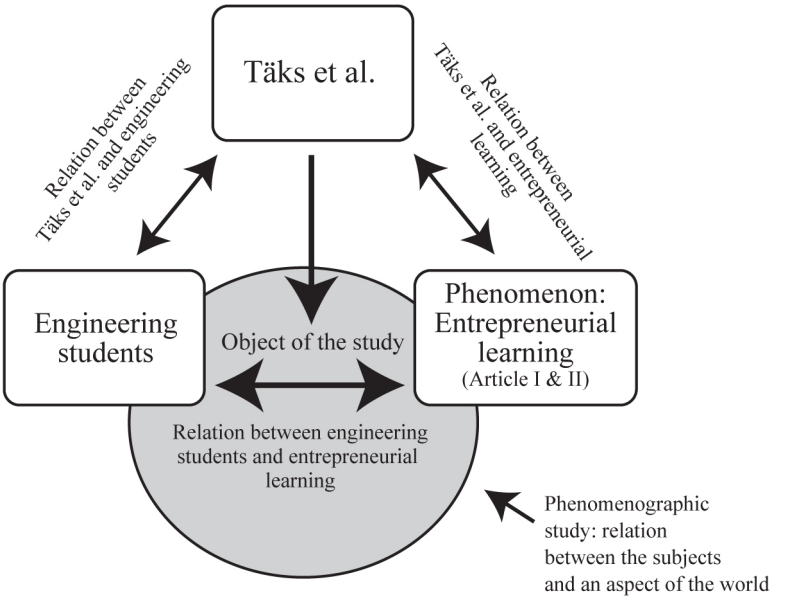

Figure 3. Focus of phenomenographic research (based on Bowden, 2005, Figure 1.1, p. 13) modified in light of the current study.

It should be noted that although the phenomena "studying" and "learning" can be conceptually differentiated, they are nonetheless closely related to each other – so much so that they are often used as synonyms. Studying is an activity that intends to bring about learning, both in the form of learning processes and outcomes. Learning, in turn, is a process and an activity that aims to bring about changes in thinking or actions and thus in the outcomes of actions. For example, Zimmermann (2002) states that learning is seen as an activity that students proactively undertake for themselves rather than as a hidden event that happens to them in reaction to teaching (p. 65). In addition, the concepts of experiencing and understanding should not be seen as synonyms, although both expressions relate, to a certain extent, to what people have in their minds (Marton & Pong, 2005). For example, experiencing can be seen manifested in a person's immediate expression of feelings and emotions, whereas understanding can be manifested as conceptualising other people's feelings, emotions or experiences, or something that is not directly experienced by a person.

Studying engineering students' experiences and conceptions of entrepreneurship education helps to understand what should be done in order to enable students to move toward gaining a deeper understanding of entrepreneurial learning and to apply teaching practices accordingly.

4.2.2. Outcomes of phenomenographic studies

The results of phenomenographic studies are presented in the form of "categories of description" (Marton, 1981, 1986; Marton & Booth, 1997). The descriptive categories characterise similarities and differences in meaning and reflect the qualitatively different ways in which phenomena can be described, analysed, understood and experienced (Åkerlind, 2005a, 2012; Barnard et al., 1999; Collier-Reed & Ingerman, 2013; Marton, 1981, 1986; Marton & Booth, 1997; Marton, Dall'Alba, & Beaty, 1993; Svensson, 1984, 1997; Rovio-Johansson, 2013; etc.). Marton and Booth (1997, p. 125) have suggested the following three criteria for assessing the quality of these types of categories:

1) The individual categories should each stand in clear relation to the phenomenon under investigation, telling something distinct about a particular way of experiencing the phenomenon.
2) The categories have to stand in a logical relationship with one another; in a relationship that is frequently hierarchical.
3) The system should be meaningful – as few categories as possible should be demonstrated to reasonably capture the critical variation in the data.

The collection of structured categories is called the "outcome space" (Åkerlind, 2005a, 2012; Collier-Reed & Ingerman, 2013; Marton, 1981, 1986; Marton & Booth, 1997, etc.). In order to arrive at the outcome space, the researchers have to look for common themes in the meanings expressed by students. Phenomenographic studies also often identify what are called *dimensions of*

variation. These dimensions are those aspects that vary between the categories. Identifying these dimensions is essential for developing categories that will describe the different and meaningful ways in which a group of students conceptualise a phenomenon (Trigwell, 2006). The categories and the dimensions of variation that are the outcome of this dissertation are presented in Articles I and II, in Table 2 and 3 accordingly, and in the Results chapter of this report.

4.2.3. Misconceptions and misinterpretations in phenomenographic research

There have been a number of misconceptions and misinterpretations regarding the orientation of phenomenographic research throughout its development. Thus, the following list of aspects should be considered when undertaking phenomenographic research:

1) Phenomenography was not developed on the basis of phenomenological philosophy and is not completely part of the phenomenological tradition (Marton & Booth, 1997; Svensson, 1997).
2) Objective reality is not presumed nor investigated in phenomenography (Marton, 1995).
3) Phenomenography is not a content analysis: The outcome is not a list of categories referring to different entities (Marton, 1995).
4) Phenomenography does not focus on the behaviours of different acts in the way that psychology does, but rather on "ways of experiencing" (e.g., learning, remembering, thinking, solving problems, and so on. (Marton & Booth, 1997, p. 114–116).
5) Personality type is not an object of research in phenomenography (Marton, 1995).
6) Phenomenography is not about discovering different things, but about different ways of seeing the same thing (Marton, 1995).
7) Phenomenography does not aim "to describe the knowledge quantitatively, like in most knowledge tests, where the results are given in the form of points or grades […] but in terms of the individual's understanding of something in terms of meaning that this something has to the individual, irrespective of the status of the experienced meaning in relation to demands for objectivity and inter-subjectivity" (Svensson, 1997, p.163–164).
8) The categories of description in phenomenography are forms of expressing conceptions, not the general characterisations of conceptions (Svensson, 1997).

All in all, phenomenography is simply an attempt to capture critical differences in how people experience the world and how they *learn* to experience the world (Marton, 1995, p. 180).

4.3. General overview of thematic analysis

Article III of this dissertation used thematic analysis as the main research method. Thematic analysis is recognised as an accessible and theoretically flexible approach to analysing qualitative data in a way that captures the important concepts within a data set (Braun & Clarke, 2006; Ryan & Bernard, 2003). Thematic analysis is a qualitative type of analysis, the idea of which is to identify important themes from the descriptions of a data set. These descriptions are closely related to the investigated phenomenon and highlight experiences, meanings and the perceived reality of the participants (Braun & Clarke, 2006). The process for identifying themes is iterative and involves reading and rereading transcripts many times, until certain patterns within the data are recognised. At a later stage of the thematic analysis, these identified patterns are then organised into categories. Thematic analysis, being a flexible and useful research tool, offers theoretical freedom that can potentially provide a rich and detailed account of qualitative data and can be used within many different types of theoretical frameworks (Braun & Clarke, 2006; Holloway & Todres, 2003), not only as part of a specific method (Boyatzis, 1998). This makes thematic analysis an important and useful tool for every researcher. Although this approach is widely used, there is an ongoing debate about how it should be undertaken (Boyatzis, 1998; Braun & Clarke, 2006). That is why it is critical that the process of the thematic analysis is explicitly presented (Attride-Stirling, 2001). For example, reporting on the assumptions taken in the analysis, how the process of analysis is organised, and how the coding process is conducted.

Thematic analysis can involve both the data-driven *inductive* approach (Boyatzis, 1998; Braun & Clarke, 2006) and the *deductive* approach (Braun & Clarke 2006), or a combination of these (Fereday & Muir-Cochrane, 2006). The inductive approach was applied in the study reported in Article III, since the themes that resulted from that study were explorative and emerged from the data; that is, the themes were not defined before the interviews.

The importance of the themes relates to: 1) how often they appear; 2) how extensively they appear in regard to the ideas and practices; 3) how people react when the theme is dishonoured; and 4) the extent to which the number, force and variety of a theme's manifestation is controlled by a specific context (Ryan & Bernard, 2003).

The coding process of the themes plays a crucial role in the analysis process and involves noticing important moments and coding them (Boyatzis, 1998). As has been pointed out, "a 'good code' is one that captures the qualitative richness of the phenomenon" (Boyatzis, 1998, p. 1).

This may be the rationale behind thematic analysis being used in a large number of studies. All in all, this methodological approach makes it possible to analyse rich and detailed qualitative data that can then be used within different theoretical frameworks (Braun & Clarke, 2006).

4.4. Data collection

4.4.1. Interviewing

The main data collection method in phenomenography and in thematic analysis is interviewing, and it was also applied in this study. The main aim of an interview is to explore the interviewee's experience of a phenomenon in depth. It has been suggested by several researchers that the interview questions for phenomenographic interviews should be as open as possible (Åkerlind, 2005b; Bowden, 2000; Kvale, 2007; Marton, 1986). This is important because the interviewer seeks to acquire descriptions of the interviewees' life and the meaning they attribute to certain phenomena (Kvale, 2007). Moreover, it is quite important what questions are asked and how they are asked (Åkerlind, 2005b; Marton, 1986). Furthermore, unstructured follow-up questions can be used to elaborate on a topic or check the meaning that interviewees associate with key words that they use. The aim is to provide opportunities for the interviewees to describe their current understanding of the phenomenon in question as fully as possible (Åkerlind, 2003, 2005b, 2005c).

During the Estonian study (Article I and II), the interview guidelines for the data collection phases were prepared beforehand and discussed in detail between the researchers in order to ensure consistency and smooth flow as well as appropriate depth concerning the interviews, which is necessary in phenomenographic research (Åkerlind, 2005a, 2012; Bowden, 2000). The interviews began with activating and open questions, with the students being asked to explain how they felt about entrepreneurial learning as part of their engineering studies and what they considered to be the main learning points. In addition, among other points, they were asked to describe the issues handled during the learning sessions and to compare the course with other courses in their study programme. When clarification was needed, additional questions were asked, such as, "Could you explain that further?" or, "Could you give an example?" – always keeping in mind the purpose of the study and phenomenon in question. The interview guide is described in more detail in Article I and Appendix A (Täks et al., 2014).

The interviews that were conducted in Finland and Namibia (Article III) were also semi-structured, in-depth individual interviews. The interview guidelines were prepared beforehand and the main questions asked in the interviews remained the same across all three interviews, that is, at the beginning, in the middle and at the end of the programme. Depending on the progress and time scale, some questions were added at the second and third interview stage. The comparison of the Estonian study and Namibia and Finnish study is given in Appendix 1. The selection of the questions mentioned in this concluding dissertation is based on the similarities between the interview guidelines for the three countries, so not all of the questions addressed during the interviews are presented here.

4.3.2. The sample and data collection in Estonia

The Estonian participants (n = 48) were full-time, fourth-year engineering students from three different disciplines (automotive engineering, technical design, textile and resource management), and the average age of the participants at the time of the research was 24 years and 6 months. The majority of the participants joined the engineering study programme either after graduating from upper secondary school or after a few years of work experience. All of the participating students went on to acquire a higher engineering certificate with 240 credit points as a result of their four years of study. The entrepreneurship course was a compulsory part of their curriculum. The Estonian data were collected in two phases: firstly, group interviews were conducted shortly after the course, and, secondly, individual interviews were held two to three months after the course. More detailed overview of the Estonian sample can be found in Table 3.

Table 2. Overview of the Samples of the Semi-Structured Group Interviews and the Individual In-Depth Interviews (Articles 1 and 2).

Sample of group interviews (n = 48, average age 24.6 years)		Sample of individual in-depth interviews (n = 16, average age 24.8 years)	
Automotive Engineering, 2 groups (n = 34)	Resource Management in the field of Clothing and Textiles, 1 group, and Technical Design together with Technology of Apparel, 1 group*; both groups (n = 14)	Automotive Engineering (n = 10)	Resource Management in the field of Clothing and Textiles (n = 6)
Male = 33	Female = 14	Male = 9	Female = 6
Female = 1		Female = 1	

* The students of Technical Design and those of Technology of Apparel were not able to participate in individual interviews due to their internships at companies.

The Technical Design Curriculum is designed to develop knowledge and skills that enable learners to create and develop clothing designs by using the latest technological equipment and programmes. This specialisation requires the ability to handle production processes, production design, and management. The Textile and Resource Management Curriculum is more focused on topics that relate to production processes. In this specialisation, it is important to understand and handle purchasing and sales processes that support production. These two aforementioned groups were joined into one large group for the entrepreneurship course. The Automotive Engineering Curriculum is designed to provide specific knowledge and skills for working in the changing technological environment of the automotive industry, with the possibility to specialise either in traffic control and maintenance or as a specialist car repair mechanic.

Due to the large numbers of students in the automotive engineering programme and its arrangement of time schedules, it was not possible to combine all student teams into one large group.

In considering the number of students, the suggested length of the interviews, and the resource-intense processes of phenomenographic research, it was decided to use group interviews for the study. The group interviews were video recorded and involved 48 (89%) of the total of 54 students. Six students were not able to participate due to illness or work responsibilities. Four group interviews (n = 48) were conducted separately with each group (17, 17, 6, and 8, respectively) on different days, each time immediately following the teaching session of the course. The group interviews were video recorded and each one lasted approximately 90–120 minutes. After conducting the group interviews, it became clear that the descriptions of the experiences that students shared during the interviews were incomplete; this was thought to have been due to the large number of students in each group. As a consequence, it was decided to conduct additional, individual in-depth interviews with selected students (n = 16) approximately two to three months after the course. The individual interviews lasted 40 minutes each, on average. The students' permission for both recordings was requested before the interviews. The rationale for selecting interviewees was to ensure that the maximum variation in students' experiences of the phenomenon in question would be represented. To capture the largest variation possible, the selection was based on students' self-assessments and their final grades in the course (to make sure that the sample included students with different achievement goals and levels). Therefore, both high and low achievers were invited. Self-assessment was mainly based on self-monitoring scales that students had to fill out twice, that is, at the beginning and at the end of the course. Those students whose self-monitoring scales illustrated the largest and the smallest changes in personal awareness among engineering students were selected to participate in the study. All of the individual interviews were audio recorded and transcribed verbatim, and these transcripts were the focus of the analysis.

4.3.3. The samples and data collections in Finland and Namibia

In Finland and in Namibia, the data were collected in conjunction with: 1) the Proacademy programme of Applied Sciences in Tampere, Finland; and 2) the Prolearning programme in Windhoek, Namibia. In Finland, six male and twelve female students (N = 18), aged 22 to 26 years, and in Namibia, seven male and six female students (N = 13), aged 22 to 24 years, participated in this longitudinal study.

In Finland (N = 18) and Namibia (N = 13), the data were longitudinally gathered through three individual in-depth interviews: one at the beginning, one in the middle, and one at the end of the programme. In Namibia, an additional, fourth interview was held (n = 10) almost one year after the end of the

programme. The average length of the interviews was approximately 60 minutes, in both Finland and Namibia. Both the Finnish and Namibian interviews were conducted by the same researcher. All of the interviews were audio recorded and transcribed verbatim.

4.5. Data analysis

4.5.1. Phenomenographic data analysis (Articles I and II)

In phenomenographic data analysis, the variation in the interpretation of the phenomenon being examined is the object of research. Therefore, the researcher is looking for qualitatively different ways in which different participants have experienced the phenomenon in question (e.g., entrepreneurial learning). The analysis of the interviews is iterative, that is, the researcher repeatedly reads through transcripts searching for meanings, and compares and contrasts the data for similarities and differences as well as looking for key relationships between themes (Åkerlind, 2003). This process should lead to a set of stable categories of description, that is, to an outcome space.

In line with Bowden's (2000) advice, the data analysis in this study started only once both the group and individual interviews had been completed and transcribed. At the beginning of the analysis, all of the data were combined; subsequently, these two sets (group and individual interview transcripts) of data were analysed as a whole. The analysis proceeded with the dissertation author being responsible for the data analysis, consulting (almost daily) the other researcher(s) as part of the process. The responsible researcher read and reread the transcripts several times and made initial allocations in each transcript to form draft categories. Next, the second researcher went through the same process, but in isolation from the responsible researcher. After both researchers completed the task, the initial results were compared and discussed. Points of disagreement were contrasted against the transcripts and discussed with the third researcher until the final descriptions that best reflected the students' qualitatively different ways of understanding the phenomenon in question were compiled. Thus, categories and their structural relationships were defined collaboratively by the researchers.

Simultaneous horizontal analysis allowed identifying the dimensions of variation, that is, the aspects that vary between the categories. The horizontal analysis followed the same procedures as the identification of the categories. Thus, the identification of the categories and the horizontal analysis of the dimensions of variation overlapped. The categories and dimensions of variation were arranged and rearranged until they formed the final categories and dimensions (Åkerlind, 2005a, 2012; Marton & Booth, 1997). The process of analysing the data lasted approximately seven months in total. The aim was to ensure the trustworthiness of the findings.

4.5.2. Thematic data analysis (Article III)

In Article III, three different data sets from three different countries (Estonia, Finland, Namibia) and contexts were combined and analysed. Initial examination of the combined data revealed significant similarities between the different entrepreneurship courses when it came to the emotional state of the learners during the entrepreneurial learning processes. Therefore, the emotional aspects of learning were chosen as a focus of further examination in Article III. Thematic analysis appeared to be the most suitable analysis method for reporting meanings, views and experiences of this phenomenon (Braun & Clarke, 2006; Kvale, 2007), since certain themes appeared to strongly emerge from the combined data.

While planning the analysis, particular choices regarding how to undertake the analysis were discussed between the researchers, such as concerning the analysis type, the focus and the process. The method chosen for this analysis was inductive, where the aim was to discover themes that were apparent in the data (Braun & Clarke, 2006). The idea was to make detailed descriptions of the sources and dynamics of the emotions that the students experienced during the entrepreneurship course. Thus, keeping the research aim of identifying sources and dynamics of emotions in mind at all times, the focus during the analysis was on finding similarities, that is, themes that could be identified across all three data sets (Estonia, Finland, Namibia). Thus, the study reported in Article III focused on finding similarities within the different data sets, whereas in the studies summed up in Articles I and II, where phenomenography was used, the aim was to identify the differences between students' experiences of entrepreneurial learning.

All data collections undertaken in the three different countries for this dissertation were initially conducted as separate research projects. In the end, the data sets from the different countries and contexts were treated as one in order to identify the similarities and differences between them. This process was quite complex since the original data were recorded and/or transcribed in three different languages: English, Finnish, and Estonian. Fortunately, two of the three researchers were familiar with the Finnish and English languages, and the third researcher with these as well as the Estonian language.

Due to the slightly different research aims, and therefore slightly different guidelines for the interviews, it was necessary to map all of the questions used in the interviews in order to assess the similarities. Identified mutual interview themes included, for example: 1) the comparison of the entrepreneurship course with courses on other subjects; 2) discussions of the issues that were handled and learned during the course; 3) discussions on the role of learning entrepreneurship during the course; 4) discussions regarding the motivation, relation, and emotions toward the entrepreneurship course and entrepreneurial learning; and 5) expectations as well as reservations in response to the pedagogy experienced (see details in Appendix 1).

During the analysis process, there was an ongoing discussion between the researchers about identifying patterns and themes as well as regarding the coding. In order to identify the sources of emotions in the entrepreneurship courses taught in the three countries, and to discern significant themes and sub-themes, Braun and Clarke's (2006) six-phase model of thematic analysis was used as described next.

First phase: *Getting familiar with the data.* This data process started with reading the transcripts and discussions between the researchers about the data in general. At this stage, the researchers were able to identify strong student emotions as manifested in repetitive patterns that were noticed across all of the data sets. This confirmed the importance of continuing the exploration of the data with a focus on sources of emotions. Here, the first visible patterns and two possible main themes were identified from the data.

Second phase: *Generation of initial codes.* At the beginning of the analysis, the patterns that were related to the sources of emotions, both positive and negative, were recognised and coded. This meant iteratively reading and rereading the transcripts until initial codes were identified. At this stage of the analysis, it became clear that consulting existing literature on research on emotions would benefit the coding process and establishing final themes with sub-themes. Consequently, all of the researchers involved sought relevant literature to support further analysis and the reporting process. As a result, the research questions were clarified and modified, a narrower focus was taken, and the analysis could continue.

Third phase: *Search for mutual themes.* Upon deeper analysis with a clearer focus, the coding was finalised and final themes with sub-themes were established. At this point in the analysis, certain dynamics were noticed in regard to the sources of emotions, and the decision to add another research question for identifying dynamics was made.

Fourth phase: *Reviewing found themes and related sub-themes.* In this phase, the analysis continued, keeping in mind the research questions regarding sources of emotions as well as dynamics of emotions. This helped to systematically revise established themes and select the interviewees' quotes that corresponded with the themes and sub-themes and to assess their relation to the learning dynamics.

Fifth phase: *Defining and naming the themes.* During this phase of the analysis, the themes were given final names and key aspects for the research report were defined.

Sixth phase: *Producing the results.* The representative interviewee quotes from data were selected and tested against the data, themes and sub-themes, and the results of the analysis were produced.

During all six phases of the analysis, the researchers kept iteratively moving back and forth between the coded data sets and discussed the findings in the process. The process itself did not follow the six-step model at all times, since the researchers had to sometimes move back and forward between the phases. However, all six phases were carried out.

As mentioned before regarding the third phase of the analysis, certain dynamics of emotions started to emerge more clearly. Thus, to answer the research question concerning dynamic patterns of emotional aspects, and to illustrate the results relating to the first research question in regard to the sources of emotions, more systematic analysis for identifying dynamic patterns of emotions was needed. Thus, a later stage of the analysis involved locating where the identified interviewee quotes had appeared during the learning process. Both positive and negative emotions were found to have appeared in the different learning situations. Interviewee quotes relating to identified themes and sub-themes helped to maintain the intended focus during the analysis, and eventually the main dynamic patterns that had occurred throughout the learning process were defined along a spectrum from negative to positive emotions. Finally, in the last stage of this iterative, systematic analysis, the expressions of emotions were divided into three main categories on the bases of the prevalence in different phases of the entrepreneurship course. These three categories highlight the dynamics of emotions during the different phases of the learning process (see Figure 4).

Both the thematic analysis and the systematic analysis for identifying patterns of emotions were accompanied by daily discussions between the researchers, mostly via Skype but sometimes, whenever it was possible and when it was crucial to the analysis process, in face-to-face meetings.

To summarise the Methodology chapter, an overview of the three different perspectives that were studied during this dissertation (Articles I, II, and III) are presented in Table 3.

Table 3. Overview of Three Different Perspectives That Were Studied to Answer the Overarching Research Questions

	Research questions	Methods	Publication forum
1.	How do engineering students experience studying entrepreneurship as part of their study programme?	Phenomeno-graphic analysis	STUDY/ARTICLE I "Engineering Students' Experiences of Studying Entrepreneurship"; *Journal of Engineering Education, 103*(4), 573–598. doi: 10.1002/jee.20056
2.	What conceptions of entrepreneurial learning do engineering students express in the entrepreneurship course?	Phenomeno-graphic analysis	STUDY/ARTICLE II "Engineering Students' Conceptions of Entrepreneurial Learning as Part of Their Education"; *European Journal of Engineering Education* (Published online, Feb. 2015). doi: 10.1080/03043797.2015.1012708
3.	What are the sources of negative and positive emotions in entrepreneurship education?	Thematic analysis	STUDY/ARTICLE III "The Sources and Dynamics of Emotions in Entrepreneurship Education learning process"; *TRAMES: Journal of the Humanities and Social Sciences*, *17*(4), 341–346 (Dec. 2013). doi: 10.3176/tr.2013.4.02
4.	What types of dynamic patterns of emotions can be identified in students during the entrepreneurship course?		

In the following chapter, the results of the three studies (Articles, I, II, and III) will be presented consecutively, as shown in Table 3.

5. RESULTS

This chapter will summarise the results of the three studies (Articles I, II, and III) conducted as part of this dissertation.

5.1. Engineering students' experiences of studying entrepreneurship (Article I)

The purpose of this phenomenographic study was to investigate how engineering students experienced studying entrepreneurship as part of their study programme (Täks et. al., 2014). The study was conducted in connection with the Estonian entrepreneurship course, which applied a socio-constructivist approach to learning and followed the integrative pedagogy model (see Article I) as basic principles. The analysis of engineering students' experiences of studying entrepreneurship produced four nested and inclusive categories (Table 4). Studying entrepreneurship as part of the compulsory study programme was experienced as: 1) a first step toward self-directed learning; 2) a preparation for work life; 3) a path to possible self-employment; and as 4) a context for developing leadership and responsibility for team achievement. These qualitatively different categories distinguished each other in seven dimensions of variation, namely: purpose of learning, expectations of the course, emotions involved during the course, teamwork orientation, experienced learning outcomes, importance in the curriculum, and attitude toward entrepreneurship.

The entrepreneurship course consisted of students with different goals (from developing self-direction skills to developing oneself) and learning expectations (from learning answers to enhancing skills through group achievement). In categories 1 and 2, active team learning was experienced as a complex undertaking followed by negative emotions, namely: anxiety, stress, confusion and even reluctance. In both categories 3 and 4, emotions were positive due to the raised self-confidence (cat. 3) and enhanced skills (cat. 4). Teamwork varied throughout the categories from complex and one-way communication (cat. 1), to better interaction (cat. 2), to experiencing "our team" (cat. 3), and finally to "my team" (cat. 4) representing taking responsibility for the team's achievement.

Consequently, learning outcomes were experienced differently throughout the categories, from gaining new knowledge, skills and better self-awareness (cat. 1), to overcoming challenges (cat. 2), to new self-confidence and motivation (cat. 3), and finally to developing leadership skills (cat. 4).

Throughout the dimension of variation that highlighted the perceived importance of entrepreneurship education within engineering studies, expressed opinions varied from entrepreneurial learning being useful to being in favour of its wider integration in curricula. This variation also reflected the attitude toward entrepreneurship throughout the categories, from it not being seen as a personal option (categories 1 and 2), to being interested in possible self-employment in the future (categories 3 and 4). Thus, the attitudes toward

entrepreneurship varied in regard to considering becoming an entrepreneur. The outcome base of the first study (Article I) is presented in Table 4.

Table 4. Categories of Engineering Students' Ways of Experiencing Studying Entrepreneurship As Part of Their Study Programme (Täks et al., 2014)

	Categories			
Dimensions of variation	1 – A first step toward self-directed learning	2 – A preparation for work life	3 – A path to possible self-employment	4 – A context for developing leadership and responsibility for team achievement
Purpose of learning	To develop self-directed learning	To develop self-regulation skills and gain knowledge for one's future work life	To develop team-working skills and prerequisites for entrepreneurship	To develop oneself
Expectations of the course	Right answers; guidance; group support	Deeper under-standing	Enhanced skills	Enhanced skills and getting confirmation via group achievement
Emotions involved during the course	Negative→ high	Negative↔ positive	Positive→high	Positive→high
Teamwork orientation	Group→ student	Student↔ group	"Our team"	"My team"
Experienced learning outcomes	New knowledge and skills; better self-awareness	New knowledge and skills; overcoming the challenges	New knowledge and skills; con-fidence and mo-tivation to con-tinue learning	New knowledge; confidence in and development of leadership skills
Importance in the curriculum	"Could be useful and supports personal development"	"Must be useful for personal development and prepares one for future work life"	"Should be applied more widely"	"Should be integrated"
Attitude toward entre-preneuship	Not a personal option	Not a personal option	Self-employ-ment as an entre-preneur is a pos-sible personal option	A possible personal option after gaining some work experience

5.2. Engineering students' conceptions of entrepreneurial learning (Article II)

The aim of this study (Article II) was to investigate what conceptions of entrepreneurial learning engineering students express related to the entrepreneurship course within their study programme (Täks, Tynjälä, & Kukemelk, 2015). This analysis produced the following four, qualitatively different categories: 1) applying entrepreneurial ideas to engineering; 2) understanding entrepreneurial issues in a new way; 3) action-oriented personal development; and 4) self-realising through collective effort (Table 5). The differences between the categories appeared in four dimensions of variation, namely: nature of learning, response to pedagogy, relation to teamwork, and experienced outcomes.

The nature of learning varied throughout the categories, from being reproductive (cat. 1), to transformative (cat. 2), to developmental (cat. 3), to socio-visionary (cat. 4), illustrating how learners approached their learning. The results indicate that the response to the type of pedagogy is closely related to the nature of learning and whether the students are more oriented toward teacher-centred *reproductive* (traditional) or student-centred *meaning-seeking* (constructive) learning. Thus, in the first category the response to the pedagogy was confusion, in category 2 it was adjustment, and in categories 3 and 4 it was enthusiasm. When interpreting the results, it should be remembered that engineering education in Estonia is mainly based on teacher-centred (traditional) pedagogy. This means that the type of pedagogy applied in this entrepreneurship course was new to most of the participating students. This might also be an explanation for the dimension *Response to pedagogy* emerging from the data rather strongly, even though the focus of the interviews was to find out about how students went about learning.

The aspect of students' "relation to teamwork" was experienced in qualitatively different ways, ranging from a sense of there being "unequal contributions" (cat. 1) or a "division of teamwork" (cat. 2), to the sense of "being a team" (cat. 3) or some even "leading the team" (cat. 4). The students' different relations to teamwork revealed different kinds of group dynamics and led to different kinds of learning outcomes. Experienced outcomes regarding the entrepreneurship studies varied throughout the categories, ranging from "relating entrepreneurial and engineering issues" (cat. 1), to "understanding entrepreneurial issues in a new way" (cat. 2), to "benefitting self-confidence and future orientation" (cat. 3), to "increasing self-realising and social responsibility".

Table 5. Engineering Students' Conceptions of Learning Entrepreneurship as an Integrated Part of Their Study Programme (Täks et al., 2015)

	Categories			
Dimensions of variation	1 – Applying entrepreneurial ideas to engineering	2 – Under-standing entre-preneurial issues in a new way	3 – Action oriented personal development	4 – Self-realising through collective effort
Nature of learning	Reproductive	Transformative	Developmental	Socio-visionary
Response to pedagogy	Confusion	Adjustment	Enthusiasm	Enthusiasm
Relation to teamwork	Unequal contribution	Divided work	Sense of being a team	Leading the team
Experienced outcomes	Relating entrepreneurial and engineering issues	Understanding entrepreneurial issues in a new way	Self-confidence and future orientation	Self-realising and social responsibility

5.3. Sources and dynamics of emotions in entrepreneurship education (Article III)

Combining and analysing the data from Estonia, Finland and Namibia resulted in three cognate themes highlighting the sources of emotions, namely: 1) new kind of learning environment; 2) collaborative learning; and 3) challenging tasks (Arpiainen et al. 2013). The "new kind of learning environment" as a source of emotions in entrepreneurship education was divided into: 1) uncertainty and confusion; 2) theory vs practice; and 3) support from outside. The second source of emotions, "collaborative learning", was divided into: 1) teamwork; 2) time pressure; and 3) individual differences between the learners. The third source of emotions, "challenging tasks", included: 1) overcoming knowledge and skill gaps; 2) interacting with the real world; and 3) leadership and managing people. In all identified themes, both positive and negative emotions were identified. All of the identified themes represent pedagogically important aspects of the learning process. The first theme and its sub-themes highlight the excitement and concerns regarding the change in learning environment from a traditional to a socio-constructivist model. The shift, which was experienced by many participants as transformative, required taking responsibility for one's own learning and generated a lot of confusion. Being in charge of one's own learning also meant being responsible for acquiring theoretical knowledge and information needed to solve problems.

The second theme, collaborative learning, can be considered to be the most central aspect of the entrepreneurial learning environment investigated in this study. In many ways, the dynamics and emotions regarding collaborative learning related to the learning environment as well to as to challenging tasks. The division of work within the team, time related issues and personal characteristics all influenced the learning process. Even though time constraints were felt to be stressful, this factor was also the thread that helped the teams to "stay on track". Students had to deliver their work on time and once they did not, their workload increased considerably for the next time and with each delay thereafter. So, anxiety regarding the workload, strict timelines, actually enhanced student involvement, participation, and the element of contribution also pushed them to deal with personal issues (conflicts) that arose during the learning process.

Challenging tasks were the third largest source of emotions and also one of the most constant stressors to overcome. However, this was also considered to be one of the most valuable contributors to achievements once successfully tackled. Once again, the outcomes were closely related to the teamwork environment and team spirit. The most difficult aspect seemed to be interacting with the outside world in connection with specific tasks, such as networking, selling one's own idea to potential customers, or developing product ideas together with customers, or even presenting the results of the team outcomes.

In addition to the sources of emotions, certain dynamic patterns in students' emotions appeared throughout the learning process. It was evident that certain emotions appeared to be more dominant in specific contexts and phases of the learning process. Based on the appearing of emotions in different phases of the learning process, they were divided into three main types: 1) emotions that dominated at the beginning of the learning process; 2) emotions that appeared important throughout the learning process; and 3) post-learning emotions. These patterns of dynamics are presented in Figure 4.

As can be seen in Figure 3, all sources of emotions – both positive and negative – are interrelated during the learning process. Collaborative learning seems to be the key theme that ties other ends together. For example, on the one hand, it has helped the team to stay on track (time management) and team members to make contributions and overcome challenges. On the other hand, teamwork seems to aid in overcoming the struggle with negative emotions. Teamwork was found to help and support students to adjust to new kinds of learning/pedagogy (new learning environment), to deal with personal issues, and to interact with the outer world as well as aiding them in other challenging tasks.

The findings also reflect the group dynamics and group forming stages throughout the different phases in the learning process. In addition, the better the teamwork environment and the more autonomy students gained, the less they seemed to experience large fluctuations between positive and negative emotions while learning. The yellow line in Figure 3 shows the students' ability

to cope with uncertainties, which seems to be closely related to students' self-regulatory abilities. Negative emotions were experienced more strongly at the beginning of the courses when the students met the transformation from traditional to activated and collaborative learning. Also, challenging tasks raised negative emotions; however, the peak in positive emotions appeared when difficult challenges were successfully tackled. As can be seen in Figure 4, negative emotions dominated at the beginning of the learning process and positive emotions were the strongest in the post-learning phase, where students were finally able to say, "We did it!"

When reading Figure 4, it should be remembered that these illustrations are suggestions and are not based on objective measures. However, knowing that meaning and the role of emotions change over time, *how* they change and *what* is causing the change is pedagogically important. Having an awareness of the sources of emotions and emotional dynamics enables the teacher to address the emotional aspects that are crucial for meaningful learning in a more systematic way.

5.4. Summary of the main findings of the study

In summing up the results of this study, the main findings are presented in the light of the research questions below. The overarching research question was: "How do engineering students experience entrepreneurship education as a compulsory part of their education?" This research question was studied from three different perspectives: 1) students' experiences of studying entrepreneurship, 2) their conceptions of entrepreneurial learning, and 3) their emotions.

The main finding gained from the study is that the engineering students experienced entrepreneurship education in qualitatively different ways. In other words, some students gained more from this kind of learning than did others, and different students valued different aspects of entrepreneurial learning. This variation in students' experiences was highlighted by four qualitatively different categories of description of studying entrepreneurship (research question 1 / Article I) and four qualitatively different conceptions of entrepreneurial learning (research question 2 / Article II). Another important finding in this study is that the students' emotions played a crucial role in learning and that sources of emotion included the entrepreneurship course being experienced as new learning environment, collaborative learning and a challenging task (research question 3 / Article III). In addition, it was found that the emotional aspects showed certain dynamic patterns throughout the time and process of learning (research question 4 / Article III).

All of the above mentioned findings are pedagogically important and contribute to enhancing teaching practices and teacher training.

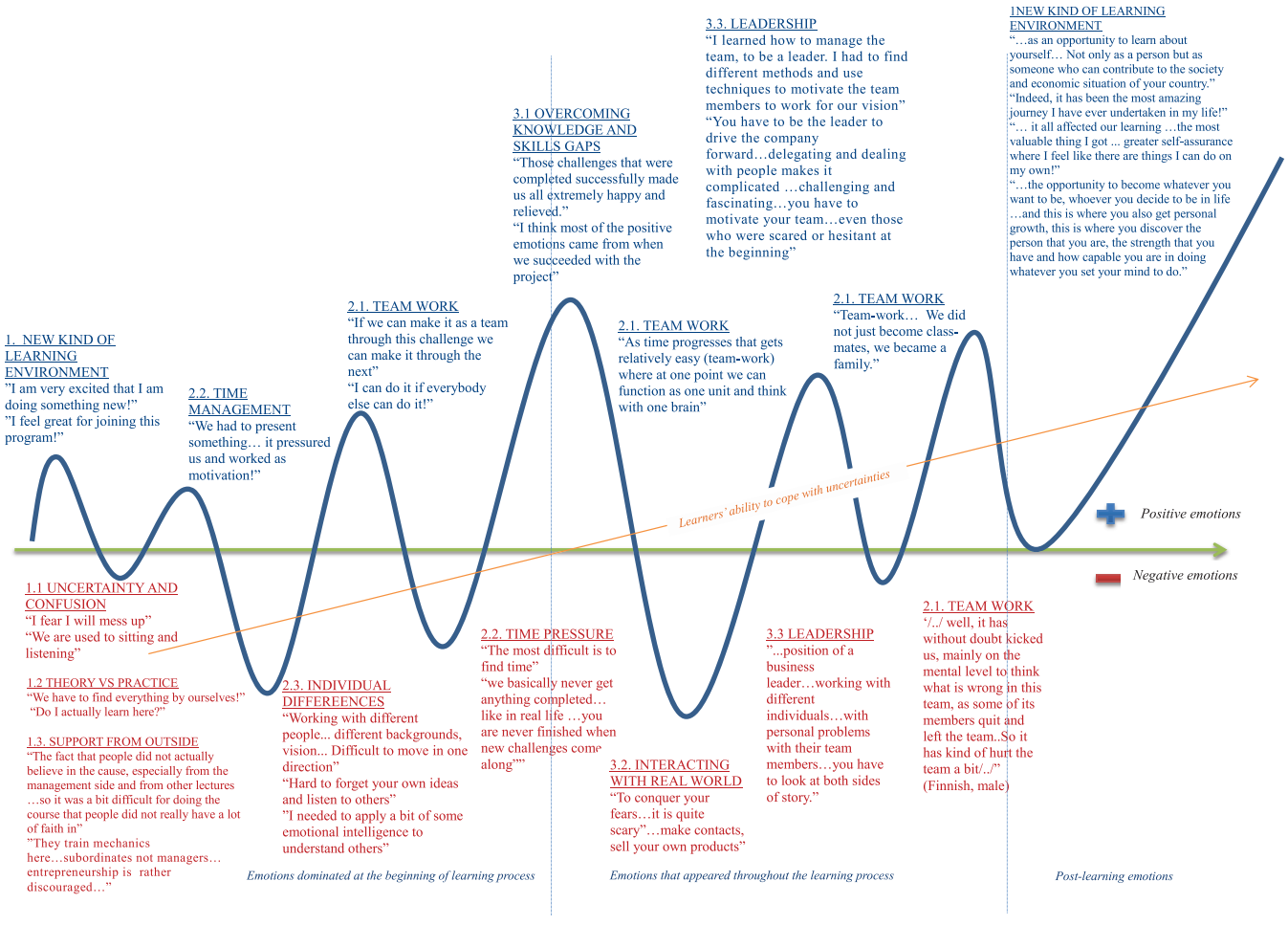

Figure 4. Waves of emotions (Arpiainen, Lackéus, Täks, & Tynjäjä, 2013, Fig. 1, p. 341).

6. DISCUSSION

In this chapter, the results of this dissertation will be discussed in the following order. Firstly, an overview of the general findings will be presented. Secondly, an overview of the scientific and methodological considerations will be given. Thirdly, the pedagogical implications of the study will be discussed. Finally, the value and contributions of the present research will be highlighted and suggestions for future research will be made.

6.1. Discussion of the key findings (Article I, II, and III)

The overarching purpose of conducting this study was to acquire a thorough understanding of engineering students' experiences of compulsory entrepreneurship education. The phenomenographic analyses of the study produced two outcome spaces (Articles I and II) reflecting engineering students' experiences of studying entrepreneurship and their conceptions of entrepreneurial learning. Both outcome spaces were hierarchical in nature, and this hierarchy was revealed through the dimensions of variation. These dimensions of variation highlight the differences between the categories of description. The thematic analysis (Article III) revealed the sources and dynamics of emotions related to entrepreneurship education.

The main finding that emerged from the study was that entrepreneurship education was experienced in qualitatively different ways by the students. In planning and implementing entrepreneurship education, it is crucial to take into consideration the variation that appeared in both phenomenographic studies. It shows, for example, that some students need more support with respect to the transformation of the learning environment and adapting to new pedagogies; some need encouragement to stand up for themselves or with time management issues.

The outcome goals of the integrative pedagogy with respect to the development of generic skills seemed to have been achieved in the students' view, as the goals appeared in all of the categories. The students' level of interest in developing an entrepreneurial mindset can be seen in their comments on the extent to which they felt entrepreneurship education should be integrated in higher engineering education. The views on this also differed between the students, from suggestions that entrepreneurship education is useful but should be voluntary to the view that it should be integrated in every subject. It is important to point out that none of the students who took part in the study perceived that studying entrepreneurship was unnecessary or not useful. The respondents' attitudes toward entrepreneurship varied. Some students concluded that they would not consider becoming an entrepreneur, some found the learning experience useful and felt it might contribute to a more successful work life later on, some felt entrepreneurship might be an opportunity to accomplish

their dreams by becoming their own boss, and some were open to all options. All in all, the students recognised this course as having been a valuable learning experience, where they had to contribute much more than has been the case in the other subjects of their studies.

A positive attitude toward entrepreneurship education and new kinds of pedagogies highlight that the directions stated by the policy makers and experts in the fields (presented in Chapters 2 and 2.1. of this dissertation) should be applied. When it comes to engineering and entrepreneurship education, and not only these, integrating new pedagogies should be applied in a way that provides multiple opportunities for individuals with different needs and achievement goals in order for them to pursue their dreams and future careers (Jamieson & Lohmann, 2009; European Commission, 2006, 2008, 2011; The Quality Assurance Agency, 2012; National Agency of Engineering, 2005; etc.).

6.2. Scientific and theoretical considerations

From a scientific point of view, the most interesting findings are related to engineering students' conceptions of entrepreneurial learning. Article II presents, firstly, an overview of the research that has been conducted in connection with students' conceptions of learning and highlights the six conceptions of learning from the most-cited study by Marton, Dall'Alba and Beaty (1993). Secondly, the findings presented in Article II reveal four qualitatively different conceptions of entrepreneurial learning. These different conceptions resemble the differences between conceptions of learning also identified by many other studies (e.g., Boulton-Lewis, Wilss, & Lewis, 2001; Boulton-Lewis, Marton, Lewis, & Wilss, 2004; Boulton, Browlee, Berthelson, & Dunbar, 2008; Marton et al., 1993; Marton & Säljö, 1979; Marton & Booth, 1997; Otting, Zwaal, Tempelaar, & Gijselaers, 2010; Paakkari, Tynjälä, & Kansas, 2011; Säljö, 1979a, 1979b, 1981; Tynjälä, 1997; van Rossum & Schenk, 1984; van Rossum, Deijkers, & Hamer, 1985; Virtanen & Lindblom-Ylänne, 2009; Yang & Tsai, 2010; etc.), and, at the same time, the findings reveal interesting shifts in learning conceptions that are illustrated in Table 6.

Table 6. Comparison of the Conceptions of Learning Presented in the Three different Studies (Täks et al., 2015)

		Study /Article II				
		Applying entre-preneurial ideas to engineering	–	Under-standing entrepreneurial issues in a new way	Action oriented personal development	Self-realising through collective effort
	Paakkari et al. (2011)					
	Repro-duction of acquired health knowledge	Application of health knowledge	Developing personal meanings on health matters	Trans-formation of individual thinking	Personal growth	Collective meaning making
Marton et al. (1993)						
Increasing one's knowledge	Memorising and reproducing	Applying	Under-standing	Seeing something in a different way	Changing as a person	–

Compared to the study by Marton et al. (1993), and two recent studies (the Article II study, and that by Paakkari et al., 2011) present a new category reflecting a conception emphasising the collective aspect in learning. This shift can be explained by the change toward collaborative pedagogical practices. Thus, the findings suggest that students' conceptions of learning will be affected when new learning environments are introduced. The new kind of pedagogy offers challenges and calls for supporting team learning practices. Students' conceptions can change over time, especially when learning environments and pedagogical practices change. This also calls for further research on socio-constructivist learning environments and for further discussions on the possible shifts in learning conceptions, as well as inviting further research on students' conceptions of learning across different settings in higher education.

6.3. Methodological considerations

In qualitative research, there is no single or simple interpretation concerning the validity of results. There have been many thorough discussions on this issue in the literature of different research fields (see, e.g., Brinkmann & Kvale, 2014; Freeman, de Marrais, Preissle, Roulston, & St. Pierre, 2007; Kvale, 1995, 1996, 2007; Tynjälä, 1991; etc.). Concepts such as trustworthiness, credibility, transferability, dependability, conformability, social validity, reflexivity, adequacy of data and interpretation, and others are used to describe validity in qualitative research (Freeman et al., 2007; Kvale, 1996; Morrow, 2005; Tynjälä, 1991). Among educational researchers, validity is usually understood as the trustworthiness of the assumptions that are drawn from the data throughout the

research process, including field notes, documents, transcriptions, interactions, and artefacts (Brinkmann & Kvale, 2014; Freeman et al., 2007; Kvale, 1996; Tynjälä, 1991).

In qualitative research, participants and researchers are always viewed culturally, historically and theoretically. Therefore, objective reality is not the aim of this type of research (Freeman et al., 2007; Marton, 1995). Also, data is data when it is recognised as such and when the researcher subjects it to some form of systematic analysis (Lincoln, 1995). Thus, qualitative researchers should make sure that the criteria for the quality of their research is presented in detailed descriptions of their study, outlining the problems encountered during their research, the reasoning behind the decisions made, and the strengths and limitations of their study. The reasons for the choices made (e.g., the researcher's theoretical interests, or other) need to be made explicit and this requires some reflexivity on the part of the researchers (Aguinaldo, 2004). Regarding the present study, the trustworthiness is discussed using the following criteria introduced by Morrow (2005):

Reflexivity of the research. Morrow (2005) states that questions of reflexivity are connected to researcher bias and how it can be minimised. In the present study, this was an important question because of the researchers' dual role as a teacher of the entrepreneurship course and a researcher of it. During the entrepreneurship course examined in the current study, learning diaries (self-reflective journals) were adopted to keep an ongoing record of the students' (and teachers') reactions and experiences. These reactions and experiences were discussed between the researchers to gain better self-awareness and to avoid assumptive biases. In the later analysis and data interpretation phases, the initial results were discussed with several other, more experienced researchers, sometimes on a daily basis.

Representation and fairness of the research. This aspect of trustworthiness deals with the question of whose reality is represented in the research (Morrow, 2005) and is closely related to reflexivity. Phenomenography itself emphasises the second-order perspective – in this case, the students' reality. This means that the researcher's task is to interpret and describe this perspective as realistically as possible (Marton, 1981, 1986; Bowden, 2000). During the current study, the interpretation of the students' reality was discussed with more experienced researchers, consulting their expertise whenever felt necessary. Morrow (2005, p. 254) has pointed out that the representation and fairness of the research pertain to the researchers involved in the process; in the present case, stepping out of the role of the teacher and taking the position of the "naïve inquirer". Becoming a researcher can be considered as having been one of the most crucial challenges in conducting the current study. For the teacher acting as a novice qualitative researcher, it was difficult to find the balance between achieving the appropriate depth of data and remaining a neutral inquirer during interviews with students.

Starting the data collection with group interviews can be efficient and less time consuming. However, there was a lot going on during the group interviews, namely, many interesting questions that were not necessarily related to the purpose of the study were raised during the interviews. Thus, maintaining the determined focus and acquiring relevant information about the students' learning experiences made conducting the interviews a challenging undertaking. Moreover, Morrow (2005) points out that "memory has a way changing over time, in part because the original interview served as a catalyst for change" (p. 254). As regards the present study, phenomenographic interviews were held at two time points: first, immediately after the entrepreneurship course, after the student teams completed their final business plan presentations and individual self-evaluation survey (group interviews); and second, two months later (individual interviews). Therefore, it is important to reflect on whether and how the two-phase data collection process with group and individual interviews may have affected the study results. Being a novice to research in general and to qualitative phenomenographic research in particular, it was difficult to see whether the collected data achieved the appropriate depth. This deficiency was discovered only when the analysis phase started. Gaps in the data were discovered in cooperation with experienced researchers, and subsequently a new data collection round of individual interviews was prepared. By the second round of interviews (individual) most of the students had left for internships, so arranging interview times turned out to be challenging. Due to this, it was impossible to collect the new set of data before 2–3 months after the course. This increased the possibility that students might not remember the details of the issues dealt with during the course. Surprisingly, even for the interviewees themselves, the learning experiences and course content were remembered rather well. Some of the students even mentioned that looking back on the course after some time made some of their learning more visible than would have been the case immediately after the course. This proves the point of memory changing with time, as mentioned by Morrow (2005), which might have added to the fairly positive tone regarding the learning outcomes of the entrepreneurship course. However, the interviewees also reported being able to express their negative emotions more boldly after having had some time and space to step away from the experience of learning entrepreneurship.

Adequacy of data. In qualitative research, the appropriate sample size can vary from 5 to 50 participants, depending on the circumstances and methodology, and the guiding principle for the adequacy of the sample is usually related to the concept of data saturation (Mason, 2010). In this study, all of the participants in the course (except those who were absent) were interviewed to ensure a maximum variation, which is important in phenomenographic research. Thus, the sample consisted of 48 students (89%) out of a total of 54. To ensure adequate variation, the selection for the individual interviews was based on students' self-assessment and their final grades in the course. The saturation of

the data occurred during the 7th interview and was confirmed after the 11th interview. Thus, it can be concluded that the data are adequate.

Adequate variety and interpretive status of the evidence. To gain adequate evidence as well as deep and rich data, it is recommended to use multiple sources of data (Morrow, 2005, p. 255). In the present study, such data stem from peer evaluations and team memos that reflected learning outside the classroom. In addition, the teachers were keeping reflective diaries containing field notes and observations. All of these collected data were used as resources for clarification when questions arose during the data analysis. Also, sufficient time and intensity was given to the data analysis. For example, the analysis that is presented in Articles I and II took approximately 7 months. About the same amount of time was needed for the analysis for Article III. This also included leaving time for crystallising, discussing and re-evaluating the findings in order to make sure that the results contributed to achieving the set goals and to ensure the "truth value" of the evidence. In addition, the longer periods of analysis helped to step out of the "lived experience" in order to see the phenomenon more objectively.

Adequacy of interpretation. This requires that the analytic framework of the data is sufficiently highlighted and springs from the overall research design (Morrow, 2005). The research design of the current study was based on phenomenography and thematic analysis. Phenomenography and other qualitative research methods have been criticised for their perceived lack of validity, lack of predictive power, high researcher bias, and ambiguity of interpretation (Hasselgren & Beach, 2000; Bowden, 2000). On the other hand, it has been said that the validity of qualitative research should be judged by the meaningfulness of its results (Åkerlind, 2005a). In the case of phenomenography, the meaningfulness of the results is seen in the consistency and sense-making of learners' experiences (Åkerlind, 2005a). What gives the present study meaningfulness is that it has yielded useful insights that can be used to improve pedagogical practices.

6.4. Pedagogical considerations

A variety of different learning theories is used in entrepreneurship education, namely, the *experiential learning theory* (e.g., Kolb, 1984), the *action learning theory* (Revans, 1981, 2011), and the *socio-constructivist learning theory* (Palincsar, 1998; Tynjälä et al., 2009, p. 271–272). This study applied the socio-constructivist approach, using the integrative pedagogy model (Tynjälä et al., 2006; Tynjälä, 2008; Tynjälä & Gijbels, 2012) as its foundation. The results suggest that integrative pedagogy is a useful and practical tool not only in entrepreneurship education but also across different subject areas. Some other recent studies also support this idea (Heikkinen, Tynjälä, & Kiviniemi, 2011; Koskinen & Äijö, 2013; Tynjälä, Häkkinen, & Hämäläinen, 2014). The integ-

ration of different types of knowledge (theoretical, practical, self-regulative, and socio-cultural) seems to support the development of students' generic skills and appears to promote creative problem solving as well as critical thinking, as students' reported experiences and their learning outcomes also suggest. Recent developments of the integrative pedagogy model, that consider students' emotional states in learning, make using it especially relevant (see Figure 1; Tynjälä, 2015). The next section will discuss the most important pedagogical implications of the present research, also drawing on some ideas from earlier studies in order to offer new ideas that can help teachers to improve their practices and provide students with more powerful learning experiences

6.4.1. Significant changes in learning environment and pedagogy: Moving toward socio-constructivist learning and self-regulation

The results of the present study show that the transformation from a traditional to a self-regulated learning environment is experienced differently by different students. For some students it can cause initial difficulties, confusion and frustration, and they search for answers and seek more structured guidance (Articles I, II, and III); others adjust easily to new situations and some are even enthusiastic about such a transformation (Article II). When students are accustomed to reproduce facts and study for the sake of tests and exams, then a rapidly changing environment and pedagogy is a new situation in which it can take them some time to find their own way of doing things and to solve problems that do not have one simple answer. This situation requires new knowledge and self-regulatory skills. Zimmerman (2000, 2002) confirms that self-regulation plays an important role in entrepreneurial learning, and he clarifies that, in educational psychology, self-regulated learning is understood in terms of self-generated thoughts, feelings and behaviours that are directed toward achieving set goals. Consequently, such a transformation can take a great amount of energy and time, which means that students need guidance regarding what is expected from them and what they will be facing during the learning process. In addition, since self-awareness seems to be a prerequisite for self-confidence and self-regulation, taking some steps toward discovering one's strengths and weaknesses is important. Students need to understand what the aim of this kind of experiencing is and in what way it is useful for them in the future. Thus, transparency and agreement concerning learning goals as well as information about pedagogic approaches and expectations, together with increased self-awareness of one's own abilities, form a good combination for starting the learning process.

As mentioned earlier in this dissertation, the entrepreneurial learning process is about learning to discover, evaluate and act on opportunities in unplanned events and unexpectedly occurring real-life situations (Jones, 2011; Rae, 2003; Cope, 2003). Students studying entrepreneurship are responsible for their own

learning and they are expected to be able to regulate their learning in a collaborative learning environment. The learning process should provide freedom, enable creativity, and allow students to choose how they go about their own learning by making their own rules and taking new roles when needed (Jones, 2011; Kyrö, 2005). Baxter-Magolda (2003) states that self-definition, in other words, awareness of one's abilities, plays a critical role in complex learning and requires reflection on one's identity and relations with others. Even more, "critical thinking requires the ability to define one's own beliefs in the context of existing knowledge" (Baxter-Magolda, 2003, p. 232). This can be achieved through, for example, self-evaluation and peer-evaluation exercises, tight work schedules, feedback, personal learning logs/diaries, and reflection. Throughout a course on entrepreneurship, students can also be asked to observe themselves and their progress as individual learners and as team members. This can have a crucial impact on how the students reconstruct their learning as a result of being aware of their strengths and limitations (see Shapiro, 1984; Zimmermann, 2002; Zimmerman & Schunk, 2001). Schmitz and Wiese (2006) suggest using personal learning diaries. However, the reflections that are required as entries to this kind of diary should be closely related to the course goals (Baxter-Magolda, 2003; Schmitz & Wiese, 2006), that is, to issues related to entrepreneurial learning; otherwise, the purpose of the learning diaries can remain vague.

Reflection and feedback play a crucial role in this kind of learning and cannot be left to rest on students' shoulders as they can be exceedingly critical of each other and are inexperienced in giving constructive criticism. Therefore, both students and teachers need tools and skills to provide constructive feedback in this type of learning process. Nicol and Macfarlane-Dick (2006) state that higher education should build up students' ability to receive and give feedback, and they offer seven *principles of good feedback* that support and develop self-regulation in students, namely: 1) clarify what good performance is, 2) facilitate self-assessment, 3) deliver high quality feedback information, 4) encourage teacher and peer dialogue, 5) encourage positive motivation and self-esteem, 6) provide opportunities to close the gap between current and desired performance, and 7) use feedback to improve teaching (Figure 1, p. 203). Throughout the course, students should be provided the opportunity to practise giving and receiving feedback. Giving constructive feedback is an essential life skill that has to be learned, for example, to succeed when working in teams and leading other people in as well as outside the working world. Students must understand the relevance and importance of this seemingly secondary learning tool/skill.

The results of the preliminary studies reported in Articles I and III indicate that acquiring theoretical knowledge in an experiential learning environment can remain somewhat tacit for learners (multiple levels of learning require time and energy and therefore outside support is needed). Thus, when students do not recognise concise theoretical knowledge in the content to be learned, they may

even feel that they have not learnt anything. This critical aspect of learning should be addressed and reflected upon, and it should be, among other aspects, integrated in assessment practices. Helping students to see the links between theory and practice and to adopt these in their own approach to learning can aid in having students recognise their relevance (Baxter-Magolda, 2003).

Applying integrative pedagogy principles and entrepreneurial learning also influences teacher practices. Teachers' role is changing from knowledge transmitter to supporter of learning, and this can be confusing and troubling at first. Michaelsen, Bauman Knight and Fink (2004) encourage teachers by highlighting that this learning process offers teachers an opportunity to learn together with their students and to have fun with it. In addition, leaving students the space to decide how learning tasks are approached and accomplished and having fun while learning enhances both learners' and teachers' creativity (Kyrö, 2005). In order to draw meaningful learning experiences from entrepreneurial learning situations, team learning support and students' personal development, the rationales guiding pedagogical practices, have to be made explicit. Also, teachers have to provide well-designed instructions, relevant theories, evaluations, and appropriate time and space for reflection (Kolb, 1984; Kyrö, 2005; Pittaway & Cope, 2007; Tynjälä, 2008; Tynjälä et al., 2009).

6.4.2. Teamwork performance and teams solving problems

The present research results (Articles I, II, and III) indicate that collaborative team learning plays a central role in entrepreneurial learning and highlight the need to address team learning issues. The examined entrepreneurship course involved a significant amount of teamwork, and it was experienced in qualitatively different ways by the engineering students, that is, from being a passive team member to leading a team throughout the course. Teamwork orientation, relationships, and personal and leadership issues were seen from different angles, and those different angles need to be made explicit for the students as well as for teachers.

Future engineers are considered the driving force for future innovation and are expected to solve complex problems collaboratively. Looking at teamwork against this background of the labour market, elaborated on earlier in this dissertation, the key theories and relevant practices concerning dealing with people and teams need to be taught. For example, in real life, whether one works for a company or is an autonomous entrepreneur, social skills such as communication and teamwork, including the ability to support team performance and innovation by motivating one's team members, are considered key success factors for both individuals and companies (Sawyer, 2007). Thus, teachers should strive to identify students with different approaches to teamwork and use this information when forming teams, and ask the more skilled team members to support those who need more guidance.

Teamwork principles can be applied to learning in different ways, but teamwork should not be confused with group work that is usually a more random form of collective work. Michaelsen and colleagues (2004, p. 12) claim that teams can be recognised by their being: 1) a high level of individual commitment to the group performance, and 2) a high level of trust between the group members. So, not any kind of group work can be called "teamwork". The process of transformation from a group to a "team" requires time for mutual interaction, different kinds of resources, challenging tasks that unite team members in striving to achieve mutual goals, and frequent feedback on the performance of both individuals and the group as a whole (Kur, 1996; Michaelsen et al., 2004; Salas, Burke & Cannon-Bowers, 2000). This highlights the importance of feedback and reflection, as already discussed in the previous paragraph of this section.

In addition, Michaelsen et al. (2004) suggest making small group work (in teams of 5–7 people) the dominant class activity. Kur (1996), as well as Michaelsen et al. (2004), suggest designing procedures that support the transformation of newly formed groups, to emphasise the advantages of the special capabilities of high-performance learning teams, and to change the course structure in order suit team learning. Michaelsen et al. (2004, p. 13) also suggest applying team learning in courses that last at least one whole school year, and to grade the group work as well as provide prompt feedback and to promote peer learning. During the learning process, teamwork can be improved through reflection and teacher feedback on each group's progress (as a team, and how they are progressing with challenging tasks). Teamwork is also a useful tool concerning issues related to time management, and, when used wisely, it can help to improve both the students' personal and team performance.

Considering the results of this study in general, and those of Article III in particular, it seems critical to point out that teams have also proven themselves to be the main source for dealing with difficult tasks and time-related issues. The present study results indicate that teams are the main source for reflection and the main source of support (when performing well) to overcome difficult tasks and negative emotions. Limited time frames and well-sequenced tasks unite teams in striving to achieve mutual tasks more efficiently, once problems that may arise between individuals have been settled. When teams do not solve their internal problems promptly or do not perform well, it can lead to low achievement/performance and even to giving up.

The teacher has to be prepared for the changes that team-based learning may demand of his or her teaching practices, and adapt the roles that are needed to support team learning. Finding the balance between team performance, providing feedback, reflecting, and adapting different roles to different situations can be demanding, since many questions that are raised in the process require a prompt reaction. The teacher's role is to notice the arising issues and conflicts either inside or between the groups and to provide the teams with the needed tools

(e.g., theoretical principles or practical guidelines, and space and time) in order to support each team's autonomous problem-solving processes.

6.4.3. Dealing with emotions

The results presented in Article III reveal that emotions play a crucial role in learning. This finding supports earlier studies, which have shown that emotions are closely related to learners' motivation, self-regulation, and learning outcomes (Pintrich, 2004; Pintrich & Zusho, 2007). The main tools for coping with emotions in transitioning from a traditional to a socio-constructivist, team-based learning environment are considered to be having constant dialogue, reflection and feedback, and a creative and supportive atmosphere. In collaborative learning, a high level of emotions, even emotional overload, was revealed, pointing out the importance of constant dialogue and solving conflicts early on. D'Mello and colleagues (2012), Sansone and Thoman (2005), Cope (2003), Pittaway and Thorpe (2012), for example, all warn that leaving emotional aspects unattended might lead to negative emotional overload and consequently to bad negative learning experiences. By being aware of the emotional aspects in learning, teachers are able to address these issues by engaging and activating/motivating students in a manner that supports positive emotions and team spirit. This kind of engagement possibly supports motivation and self-regulation and enhances deep learning (Perkun, 2006; Pintrich, 2004; Pintrich & Zusho, 2007). Understanding the dynamic patterns of emotions, in turn, helps to bring to attention what kinds of emotions appear at what stage of the learning process. This knowledge enables addressing emotional issues either in personal reflection or encouraging discussions relevant to the topic, and is useful in determining how to regulate the learning process toward positive outcomes. The present research results also highlight the importance of raising learners' awareness of their own abilities and emotional reactions to different people and situations. This kind of awareness can direct students toward better self-control and more considerate actions toward co-learners, and later on toward co-workers.

The learning environment should be organised in a way that encourages students to deal with emotions and to find learning opportunities even in failures. Thus, both negative and positive emotions play an important role in learning. It has been even suggested that not only positive but also negative emotions should be regarded as a valuable aspect of education (Kyrö, 2005). However, negative emotions should be treated with caution and in a way that turns them into positive experiences.

In sum, teachers and students should be made aware of what kinds of emotions are involved in the entrepreneurial learning process, and they should be told to expect that negative emotions may emerge. Acknowledging this and taking appropriate actions may turn emotions into sources for better self-awareness and self-regulation, which in turn may lead to deeper learning.

Therefore, students' potential emotions should be taken into account when designing learning environments, and they should be discussed in learning situations and reflected on using various tools.

6.4.4. Implications for educational management and teacher training

It would be beneficial, if the results of this study were used as input for teacher training, since learning processes and the role of emotions, as well as other aspects described earlier, can be confusing and challenging for the teachers who are changing their practices. Institutions' decision makers and policy makers should make an internal and external evaluation of what this kind of teaching/ learning practice may require in terms of school management processes. Also, teachers' workloads need to be considered critically, since providing constant feedback and being aware of students' progress through reflection takes time. This time, however, is a valuable investment in students' learning and in changing learning habits. Furthermore, workload planning and student feedback systems have to be evaluated critically and should take new kinds of learning experiences into account. It is essential to support teachers in transforming learning and teaching practices, since turning classrooms "upside down" brings many questions and uncertainties along, potentially causing teachers who decide to try to but do not understand the processes that emerge to return to their previous practices with which they felt more comfortable. Even though this study does not clearly state to what extent entrepreneurship education should be integrated in engineering studies, it hopefully adds to understanding how it can be done. It illustrates the importance of considering how this kind of learning practice can affect schools' internal and external evaluation and teachers' workload planning.

6.5. Value and limitations of the study

6.5.1. Value, contribution and implications of this study

It is rather common in entrepreneurship education research that programmes investigated are voluntary for participants and focus on preparing students to actually become entrepreneurs. The entrepreneurship course examined in the present study, however, was compulsory for the participating engineering students and had more holistic aims. On the one hand, the focus was on introducing the alternatives to engineers, that is, the option of either becoming an autonomous entrepreneur or being an intrapreneur within a company. On the other hand, the aim was to increase engineering students' self-awareness and self-regulation, and to make them think about themselves as entrepreneurial, active citizens who understand clients' values and market behaviour. Thus, the

study provided knowledge about how a compulsory entrepreneurship course is experienced by students in higher education. This is quite a novel perspective in entrepreneurship education research.

From a methodological point of view, the novelty value of the study lays in the fact that using phenomenography is rather rare with respect to engineering – especially in an entrepreneurial learning context – and not only in Estonia. Nevertheless, phenomenography proved to be a useful method to examine entrepreneurship education from the students' point of view. The study produced results that can readily be used in developing entrepreneurship education.

More specifically, the findings reported in Article I revealed the different ways in which studying entrepreneurship based on the integrative pedagogy model was experienced by engineering students. The findings support the implementation of the integrative pedagogy model in entrepreneurship education and possibly across curricula. Engineering students' experiences of studying entrepreneurship and their attitude toward entrepreneurship support and add to the discussion on the usefulness of entrepreneurship education in higher education. Further, the findings reported in Article II not only describe students' conceptions of entrepreneurial learning but also contribute to the scientific discussion on learning conceptions, illustrating the expansion of these conceptions over time that has probably occurred due to changes in teaching paradigms and practices. The findings also suggest possible pedagogical implications of this type of teaching and teacher training. Finally, the findings presented in Article III contribute particularly to understanding how, when and what kinds of emotions arise during the entrepreneurial learning process. These findings provide solid ground and opportunities for preparing appropriate instructional strategies. Educators should not be afraid of students' emotions but rather regard them as a normal part of deep learning.

All three sub-studies (Articles I, II, and III) help to increase the understanding of how to design authentic learning environments that simulate real-life issues (e.g., elements of uncertainty) in order to prepare students to deal with unpredictable and unexpected circumstances in the working world. The scientific, theoretical and methodological issues, as well as pedagogical implications, that can be considered as contributions of this study are summarised in Table 7, page 57.

Table 7. Contributions of This Study to Engineering Education, Entrepreneurship Education and Higher Education Research

Study/ Art. I	**Theoretical** – Integrative pedagogy model (IPM) modification as a theoretical framework for learning entrepreneurship. The IPM can also be applied to develop generic skills across curricula, not only in engineering education and entrepreneurship education. Findings support the implementation of the IPM in entrepreneurship education**.** **Methodological** – Using a phenomenographic research orientation in Estonia within higher engineering education to study engineering students' experiences of entrepreneurship education as part of their studies. **Pedagogical** – Better understanding of students' experiences of learning entrepreneurship as a compulsory subject and of attitudes toward teamwork and entrepreneurship in general. – Results contribute to the re-evaluation of current teacher training practices and highlight the need for mentoring in teachers' professional development. **For policy makers and school boards** – Highlighting the importance of entrepreneurship education within higher engineering education through students' own experiences.
Study/ Art. II	**Theoretical and scientific** – Overview of research on conceptions of learning. Highlighting the expansion in conceptions of learning in the entrepreneurship course over time through comparisons with different studies, stating that changes in pedagogy lead to changes in conceptions of learning with time. **Methodological** – Researching conceptions of entrepreneurial learning within higher engineering education, using phenomenography. **Pedagogical** – Better understanding of the nature of entrepreneurial learning, and teamwork contributes to the development of teaching practices. – Results also contribute to the re-evaluation of current teacher training practices, highlighting the need for mentoring in teachers' professional development.
Study/ Art. III	**Theoretical** – Findings add to previous studies on sources of emotions in learning. Previous studies were mainly conducted with younger learners, here in higher education with adult learners. **Methodological** – Linking emotional states of learners with the phases of the learning process proved fruitful. **Pedagogical** – Researching emotions in entrepreneurship education set within engineering education can contribute to designing learning experiences that prepare students to deal with uncertainties. A better understanding of the complexity and dynamics of emotional patterns in the entrepreneurship education learning process provides new ideas for instructional strategies. – The implications of this study are not limited to entrepreneurship education but may apply to various domains of education. – Highlighting the role of emotions in learning while training teachers would be valuable.

6.5.2. Limitations of this study

The main possible limitations of the present research relate to the two-phase data collection in Estonia and the dual role of the researchers, as already discussed in the Methodological Considerations section of this dissertation. It remains debatable whether or not the process of conducting a two-phase data collection (group and individual interviews) has had an effect on some of the statements made by the engineering students during the interviews. Åkerlind (2005a, 2012) suggests that one way to judge the validity of phenomenographic research is to assess the meaningfulness of the outcome space and sense making of students' experiences. The present research results suggest pedagogical implications that can be used to improve pedagogical practices, and they highlight several meaningful aspects of sense making in learning.

Another issue that is often discussed in connection with qualitative research is the extent to which the results of a study can be generalised. Phenomenography is context-bound and does not aim to investigate objective reality (Marton, 1981, 1986, 1995) but rather learners' experiences and conceptions of it. Thus, strictly speaking, the results of the present research are generalizable only with respect to entrepreneurship education conducted in a similar way as were the courses described here. However, it seems reasonable to claim that the results of this dissertational research can be applied to similar learning contexts across higher education. Having adhered to the quality requirements for qualitative research has hopefully helped to minimise the potential consequences of any limitations.

6.6. Suggestions for future research

In general, the application of phenomenography in research has been rare in Estonia. Although this dissertation does discuss aspects related to phenomenography and applies phenomenographic research, as reported in Articles I and II, it does not go into detail regarding its recent theoretical and methodological developments such as the Theory of Variation proposed by Marton and Booth (1997). In future, both phenomenographic research and variation theory could be applied more widely, since together these cognate approaches are especially beneficial in researching the learning of specific concepts that are essential for gaining professional expertise. To further explore the issues related to the results of this dissertation, future research could be more focused on teamwork orientation and team relations as well as students' expectations of pedagogical tools used in higher education; or it could concentrate on examining the learning of narrower concepts, such as, for example, specific aspects of market analysis, competition, product development, creativity and innovation.

Research on *emotions* in learning has lately become more important in education as well as in the entrepreneurship education field of research. However, a more systematic and longitudinal research approach to measuring

emotions in learning over time would offer better, more detailed and systematic information on how emotions can be beneficially used in learning. The identification of emotional patterns in this dissertation (Figure 3) can be used as a basis for designing refined instruments that measure emotions as well as to develop relevant online learning tools.

Since students are becoming more and more technology savvy, teachers need to offer and integrate Internet-based individual or team learning spaces to support students' learning. This kind of learning brings about new challenges and raises questions as to how active learning can be supported using IT tools. Thus, there is a need to know more about how face-to-face versus classroom versus online learning environments can be interwoven in entrepreneurial learning in order to enhance students' learning and its meaningfulness.

Even though the research of this dissertation did not focus on gender issues, it appeared that some female students, though often having inner drive and ideas, required a boost of empowerment and self-confidence to consider seriously pursuing their dreams. Gender differences in entrepreneurial learning/teaching and their relation to cultural/historical background, self-confidence and how things are approached or seen both by students and teachers might be an interesting issue to explore further in future research.

In general, there is a need for more research on entrepreneurship education practices across different higher education settings in Estonia and elsewhere. Policy makers and educators need to understand the different needs of students in specific subject areas, be it science, design, art or other fields. In examining the latest developments in Estonia and across the EU, it would be useful to map how entrepreneurship education is or could be approached and applied at the different levels of education, namely, in primary, secondary, vocational and higher education.

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APPENDICES

Appendix 1. Comparison of interview question guides used in the Estonian, Finnish and Namibian studies as presented in Article III (Arpiainen et al., 2013).

ESTONIA (based on individual interviews)	**FINLAND and NAMIBIA (compiled based on three different interviews of this longitudinal study)**
What was this course about? How would you describe the subject?	What do you think about your studies at ProAcademy (PA) / ProLearning (PL)? How would you describe what the PA/PL is? How would you describe it to a student who is considering joining the programme?
How would you compare this subject to the other courses experienced during your studies at higher education institutions?	What is the biggest difference when comparing learning at the PA/PL with a conventional traditional study programme?
What did you learn during this course? How? What would you consider the main learning points of this subject to be?	What have you achieved by studying in this programme? What is the most important thing that you have learnt so far in your studies at the PA/PL, and why?
What did you find most useful while learning? What made this subject worth learning?	What was the most valuable and important thing that you gained from your studies at the PA/PL?
What made this subject worth learning? What did you gain from this subject? How useful do you find this experience? Please give some examples (if needed). Why did you choose this approach?	Can you use that experience in your work life somehow? What was the most important thing for you while studying at the PA/PL?
How would you describe the issues that were handled during the course lessons?	What has motivated you in your studies in this programme? What has been the most challenging for you while studying in this programme?
How would you feel if you would not have taken this subject?	For your future, what would you say was the most valuable and important thing that you gained from your studies at the PA/PL?
How would you describe your role as a learner during the course? How do you usually go about learning? Why do you do it this way? Is learning at university different from learning at other educational institutions you know?	How would you characterise yourself as a learner? How do you feel about learning in a team, being a team member? Which of the learning tools have helped you to learn best and why?
What did you miss that should have been there when studying this subject?	What has been most important for you in your studies in this programme?
What is your conception of entrepreneurial learning in engineering education? How did you experience entrepreneurial learning during the studies in general?	How do you feel now about this way of learning entrepreneurship?
What is your view on entrepreneurial learning in comparison to the different subjects that you have encountered during your studies?	What is the biggest difference when comparing learning in this programme with traditional ways of learning?
Do you see yourself as an entrepreneurial person (in terms of actions, skills)?	Have you had any desire to be an entrepreneur? Do you still have? Are you planning to become one?

Note: Only relevant and similar questions from the Finnish and Namibian interview question guides are presented here, in Appendix 1.

KOKKUVÕTE

Inseneriõppe üliõpilaste õpikogemused ettevõtlusõppest

Uuringu taust ja teooria

Kiirelt muutuv maailm, tehnoloogilised uuendused ja üha ebastabiilsem tööturg pakuvad uusi väljakutseid nii ettevõtjatele, ettevõtetele kui tulevastele töötajatele. Ettevõtted vajavad proaktiivseid, mitmekülgsete teadmiste ning oskustega loomingulisi professionaale, kes oma tegevusega toetavad ettevõtte arengut ja innovatsiooni. Kõik see puudutab ka insenere, kellelt oodatakse nii ettevõtte heaks töötamist ja panustamist selle arengusse, kui kiiresti muutuva tööturu jaoks sobivate töökohtade loomist. Selleks, et olla oma kutsealal asjatundja (*professional expertise*) ja rajada edukat karjääri, vajavad insenerid sügavaid erialaseid teadmisi, mis kogunevad pikaajalise eesmärgistatud praktika jooksul (*deliberate practice*). Taolise praktika eeldus on, et selle käigus õpitakse lahendama keerulisi ja mitmetahulisi probleeme, tulema toime ebakindlusega, õpitakse kriitiliselt mõtlema ja reflekteerima, parandatakse eneseregulatsiooni jne. (Boshuizen, 2009; Eraut, 2004; Ericsson, 2006; Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson, Prietula, & Cokely, 2007; Litzinger, Lattuca, Hadgraft, & Newtetter, 2011; National Academy of Engineering, 2005; Rugacia et al., 2000; Tynjälä & Gijbels, 2012, etc.). Veelgi enam, innovatsiooni loomiseks ja juhtimiseks peavad insenerid mõistma, kuidas töötavad turud, teadma klientide ootusi ja tundma kliendi väärtusloome protsessi, väärtusahelat. Keeruliste probleemide efektiivseks ja edukaks lahendamiseks on vaja õppida neid probleeme nägema võimalustena arendada olemasolevat ja/või uut toodet, ärikeskkonda või ühiskonda tervikuna. Lisaks vajavad insenerid oskusi astuda reaalseid samme arendatud toodete või teenuste realiseerimiseks jpm. Seega innovatsiooni loomine eeldab nii sügavaid erialaseid kui ka üldisi teadmisi – loovust, ettevõtlikku hoiakut ja suutlikkust oma kogutud teadmisi praktiliselt rakendada.

Kuna loovus ja innovatsioon on sotsiaalsed nähtused (Sawyer, 2012), peavad insenerid olema võimelised tegema koostööd interdistsiplinaarsete ja multikultuursete meeskondadega. See omakorda tähendab heade kommunikatsiooni- ning kaasamis- ja juhtimisoskuste omandamist (Creed, Suuberg, & Crawford, 2002; Litzinger et al., 2011; National Academy of Engineering, 2005; Rugacia et al., 2000; Sawyer, 2007; Tynjälä & Gijbels, 2012).

Viimaste aastate uuringute tulemused insenerihariduses kinnitavad, et üha enam rakendatakse õppetöös ehtsaid (*authentic*) projekte, probleemide lahendamist ja teisi aktiivõppe meetodeid. Samas võib mitmete uuringute ja raportite põhjal järeldada, et tänane inseneriharidus ei valmista tulevasi insenere 21. sajandi tööturu vajadusteks piisavalt ette (Jamieson & Lohmann (ASEE), 2009; ECC, 2006; EC, 2008; Litzinger et al. 2011; NAE, 2005; SEFI, 2011 jt.).

Üks inseneriõppe arendamise ja kaasaja nõuetele vastavaks kohandamise võimalusi on ettevõtlusõppe integreerimine inseneriõppekavadesse. Ettevõtlus-

õppe käigus rakendatakse planeerimata, juhuslikult esinevaid tõsielusündmusi ja juhitakse tähelepanu probleemidele ühiskonnas (Jones, 2011). Veelgi enam, ettevõtlusõppes analüüsitakse probleeme nende majanduslikku väärtust silmas pidades, saadakse teavet ettevõtlusprotsessidest ning realiseeritakse uusi ideid tooteid ja teenuseid turule tuues, ettevõtteid ja/või uusi töökohti luues (Cope, 2003; Fayolle & Gailly, 2008; Gibb, 2002, 2008; Pittaway & Cope, 2007; Lans, Oganisjana, Täks, & Popov, 2013; Porter, 1994; Rae, 2003). Ettevõtlusõppe käigus õpitakse nägema probleeme võimalusena ja ideede allikatena, õpitakse probleemide tõhusat lahendamist, riskide maandamist ning ebakindlusega toimetulekut. Lisaks toetab ettevõtlusõpe eneseregulatsiooni ja õppija eneseteadlikkust, luues eeldused tema personaalsete arenguvajaduste ja ülekantavate oskuste (näiteks meeskonnatöö, suhtlusoskused jms.) arendamisele. Eelnimetatud tegurid annavad põhjust populariseerida ettevõtlusõpet kui võimalust kaasajastada haridust ning valmistada üliõpilasi ette vastavalt tööturu ootustele (ECC, 2006; EC, 2008; Jamieson & Lohmann, 2009; NAE, 2005; jt.). Paraku puuduvad piisavad teaduspõhised tõendid selle kohta, millised tegurid ja kuidas täpselt ettevõtlusõppe õpiprotsesse mõjutavad (Lans et al., 2013) või millised on reaalsed ettevõtlusõppe õpitulemused ning mil määral on optimaalne ettevõtlusõpet insenerihariduses rakendada (Duval-Couetil, Reed-Rhoads, & Haghighi, 2012; Duval-Couetil, 2013; Standish-Kuon & Rice, 2002). Seetõttu on oluline uurida, kuidas kogevad inseneriõppe üliõpilased ettevõtlusõpet käesoleva uuringu käigus kasutatud rakenduse kontekstis ja millised õppeprotsessid õpikogemusi kõige enam mõjutavad.

Uuringu eesmärgid

Käesoleva doktoritöö eesmärgiks oli selgitada inseneriõppe üliõpilaste õpikogemusi ettevõtlusõppest. Ettevõtluskursus, mille põhjal üliõpilaste õpikogemusi uuriti, oli kõikidele uuringus osalenud üliõpilastele kohustuslik tavapärase vabatahtliku kursuse asemel. Püstitatud uuringu eesmärki käsitleti kolmest erinevast vaatenurgast:

Uuring I (artikkel I) eesmärgiks oli selgitada, kuidas inseneriõppe üliõpilased kogesid õppimist ettevõtluskursusel. Uuringus keskenduti muuhulgas integratiivse pedagoogika mudeli põhimõtete tutvustamisele. Integratiivse pedagoogika mudel toetub sotsiaal-konstruktivistlikule õpikäsitlusele ja võimaldab integreerida nelja peamist liiki teadmist: 1) teoreetilisi/kontseptuaalseid teadmisi, 2) praktilisi/kogemuslikke teadmisi, 3) sotsiaal-kultuurilisi teadmisi, ja 4) eneseregulatsiooniga seonduvaid teadmisi (Tynjälä, 2008; Tynjälä & Gijbels, 2012). Lisaks uuringu tulemustele on artiklis lisadena esitatud detailne ettevõtluskursuse ülevaade ja läbi viidud intervjuude kava.

Uuring II (artikkel II) eesmärgiks oli uurida inseneriõppe üliõpilaste poolt kursuse põhjal väljendatud ettevõtlusõppe õpikontseptsioone. Uuringu II tulemusi võrreldi täiendavalt kahe varasema õpikontseptsioone käsitlenud uuringu (Marton et al., 1993; Paakkari et al., 2011) tulemustega.

Uuring III (artikkel III) eesmärgiks oli selgitada ettevõtluse õppimise käigus tekkinud positiivsete ja negatiivsete emotsioonide allikaid ning tuvastada nende emotsioonide dünaamilised mustrid ettevõtluskursuste (Eesti, Soome ja Namiibia) toimumise jooksul. Tulemustes käsitletud emotsioone ja mustreid kombineeriti, struktureeriti ja restruktureeriti omavahel süstemaatiliselt. Kombineerimise tulemusena saavutati õppimisel esinevate emotsioonide dünaamika graafiline esitamine selliselt, et see võimaldas illustreerida kuidas, millistes õppeprotsessi etappides ja millistest õppeprotsessidest tingituna positiivsed või negatiivsed emotsioonid esinesid (joonis 1. *Waves of Emotions*).

Uuringu valim ja metoodika

Eesti andmed (artiklid I, II ja III) koguti neljanda aasta päevase inseneriõppe üliõpilastelt, kes läbisid õppekava raames ettevõtluskursuse. Andmekogumiseks kasutati kvalitatiivseid rühmaintervjuusid, mis viidi läbi kolme eraldiseisva intervjuuna (n = 48) ja täiendavalt individuaalseid pool-struktureeritud intervjuusid (n = 16). Intervjueeritud inseneriõppe üliõpilased õppisid Tallinna Tehnikakõrgkooli kolmel õppekaval – autotehnika, rõivaste tehniline disain ja tehnoloogia, ning rõiva- ja tekstiiliala ressursikorraldus. Ettevõtlusõpe oli nende õppekavade kohustuslik aine. Rühmas oli kokku 54 üliõpilast, kuid osa neist viibis rühmaintervjuude toimumise ajal ettevõttepraktikal, mistõttu osales rühmaintervjuudel 89 protsenti rühmast. Pool-struktureeritud intervjuudele valiti üliõpilased nende teostatud personaalse enesehindamise ja kursuse lõpptulemuse (hinde) alusel. Valiku eelduseks oli saavutada võimalikult suur varieerivus õpikogemustes intervjueeritavate hulgas. Ettevõtluskursus kestis keskmiselt neli kuud.

Artiklis III kasutati lisaks inseneriõppe tudengitele (n = 48 ja n = 16) *Soome* (N = 18*) ja Namiibia* (N = 13) andmeid, mis koguti 1) Soomes, Tampere rakenduskõrgkoolis Proacademy programmi läbinud üliõpilastelt ja 2) Namiibias, Windhoekis, Prolearning programmis osalenud üliõpilastelt. Nii Soomes kui Namiibias kasutati andmete kogumiseks pool-struktureeritud intervjuusid, mis viidi läbi kolmel korral: kursuse alguses, keskel ja lõpus. Ettevõtlusprogrammide pikkus oli Soomes kaks ja Namiibias kaks ja pool aastat.

Intervjuude käigus kogutud andmed lindistati ja transkribeeriti (*verbatim*). Eesti ettevõtluskursusel osalenud üliõpilastelt kogutud andmeid kasutati uuringutes I, II ja III. Uuringutes I ja II kasutati kogutud andmete analüüsiks fenomenograafilist analüüsimeetodit. Uuringus III, kus Eesti andmed kombineeriti Soome ja Namiibia omadega, rakendati temaatilist analüüsi.

Tulemused

Uuringu I analüüsi tulemusena jõuti nelja kvalitatiivselt erineva kategooriani, mis kajastasid üliõpilaste õpikogemusi ettevõtluskursusest inseneriõppe osana. Ettevõtlusõpet kogeti kui 1) esimest sammu enesejuhitud õppimise suunas, 2) ettevalmistust tööeluks, 3) esimest sammu ettevõtjaks saamisel ning 4) konteksti, kus saab arendada juhtimisoskusi ja võtta vastutust meeskonna saavutuste eest.

Uuringu II analüüsi tulemusena sai välja tuua neli kvalitatiivselt erinevat inseneriõppe üliõpilase poolt väljendatud ettevõtlusõppe õpikontseptsiooni, milles käsitleti ettevõtlusõpet inseneriõppes kui 1) allikat ideede rakendamiseks insenerivaldkonnas, 2) allikat uue ja sügavama arusaama tekkimiseks ettevõtlusega seonduvatest teemadest, 3) kindlale tegevusele suunatud personaalset arengut, 4) eneseteostust meeskonnatöös.

Kahe esimese uuringu õpikogemuste/õpikontseptsioonide variatsioonide tulemusena toodi välja õpiprotsessis esinevad pedagoogiliselt olulised aspektid. Need pedagoogilistelt olulised aspektid aitavad mõista, kuidas toimub uuritud kontekstis õppimine ning millised meetodid õppeprotsessi planeerimisel ja rakendamisel toetavad nii õppijate enesearengut kui ka sügavamat, tähenduslikumat õppimist.

Uuring III, mille analüüsi faasis kombineeriti kolme erineva riigi, erineva pikkuse ja kontekstiga ettevõtlusõppe kursustelt kogutud andmed, jõuti kolme peamise emotsioonide tekkimise allikani: 1) uus õpikeskkond (üleminek traditsiooniliselt õppelt aktiivõppele), 2) ühine ehk koosõppimine ja 3) raskusi valmistavad (keerulised) ülesanded. 'Uus õpikeskkond' omakorda sisaldas järgmisi emotsioonide allikaid: 1) ebakindlus ja segadus, 2) teooria *vs* praktika, ning 3) tugi väljastpoolt vahetut õpikeskkonda. Teine peamine emotsioonide allikas 'koosõppimine' sisaldas 1) meeskonnatööd, 2) aja survet ja 3) individuaalsete erinevustega seonduvaid emotsioone. Kolmas emotsioonide allikas 'raskusi valmistavad ülesanded' sisaldas 1) teadmiste ja oskustega seonduvate puuduste ületamise, 2) reaalse maailmaga suhtlemise (kliendid, partnerid jt) ning 3) kaasõppijate kaasamise ja juhtimisega seonduvaid probleeme.

Kõik analüüsi käigus välja toodud emotsioonide allikad esindavad õppimises neid aspekte, mis on pedagoogiliselt olulised. Lisaks õppimises esinenud emotsioonide allikate tuvastamisele avaldusid analüüsi käigus dünaamilised mustrid, mis esinesid sarnaselt kõikidel uuritud ettevõtlusõppe kursustel, sõltumatult nende kestusest või geograafilisest asukohast. Uuritud kursuste eri etappides ilmnesid sarnased emotsioonid, erinedes lähtuvalt õppeprotsessi etapist oma avaldumise tugevuse ja emotsioonidele üliõpilaste poolt omistatud tähtsuse poolest. Ettevõtlusõppes esinevate emotsioonide dünaamikale oli võimalik analüüsi tulemusena anda graafiline vorm, mis aitab mõista, kuidas ettevõtlusõppes õppijate emotsioonid väljenduvad. Selline mõistmine loob võimalused õppija toetamiseks õppeprotsessis.

Uurimistöö väärtus

Käesoleva uurimistöö teoreetiliseks panuseks on integratiivse pedagoogika mudeli (uuritu aluseks olnud ettevõtluskursuse ülesehituseks kasutatud teoreetiline raamistik) kasutamine ja selle põhjal üliõpilaste õpikogemuste uurimine (vt. uuring I). Kasutatud integratiivse pedagoogika mudeli (edaspidi IPM) väärtus seisneb selle funktsionaalsuses ning rakendamiseks välja pakutud praktiliste õpetamispõhimõtete ja -metoodikate valikus. IPM lähtub sotsiaal-konstruktivistlikust õpikäsitlusest, mis on haridusuuringutes viimastel aastatel üks enim uuritud õpikäsitlusi. IPMi kasutamise lisandväärtus seisneb selles, et see mudel sobib rakendamiseks ettevõtlusõppes, kuid seda on võimalik kohaldada üldiste oskuste arendamiseks ka muudes õppekavades, sealhulgas inseneriõppes.

Uuring III lisab teoreetilist väärtust ja teadmist varasematele emotsioonide allikaid käsitlenud uuringutele, illustreerides tuvastatud emotsioonide dünaamikaid. Seni on uuritud peamiselt üldharidusastmes õppijate ja täiskasvanud õppijate õppimisega seotud emotsioone, mitte niivõrd üliõpilaste õppimisega seotud emotsioone.

Teaduslikuks panuseks on uuringus II tehtud kolme fenomenograafilise õpikontseptsioonide uuringu võrdlust (Marton et al. 1993; Paakkari et al., 2011; Täks et al., 2014), mille põhjal saab väita, et aja jooksul pedagoogikas toimunud muudatused on avaldanud mõju arusaamadele, mida õppijad oma õpikogemuste põhjal väljendavad ehk millised on nende õpikontseptsioonid.

Käesoleva doktoritöö metodoloogiline panus ilmneb eelkõige fenomenograafilise analüüsi kasutamises insenerihariduses ettevõtlusõppe kogemuste uurimiseks (uuringud I ja II). Fenomenograafiline analüüs võimaldab uurida õpikogemusi õppija perspektiivist lähtuvalt, tuues välja õppijate arusaamade varieeruvuse kollektiivse kogemuse näitel. Uuringu III analüüsi käigus õppijate emotsionaalse seisundi seostamine õpiprotsessi eri etappidega on metoodiliselt uudne ning võimaldab illustreerida koos nii emotsioonide põhjusi kui dünaamikat.

Doktoritöö pedagoogiliste järelduste osas tuuakse välja uuringutes I, II ja III esile kerkinud olulisimad ettevõtlusõppega seonduvad põhimõtted, mis aitavad toetada üliõpilaste tähenduslikumat ja sügavamat õppimist. Näiteks, millist mõju avaldab õppijatele üleminek traditsioonilisest õpikeskkonnast sotsiaal-konstruktivistlikule ja mida saab õppejõud teha selleks, et seda üleminekut toetada. Meekonnatööl põhinev õppimine on keskne sotsiaal-konstruktivistlikus õpikäsitluses ja ettevõtlusõppes. Sellega on seotud mitmekihilised ja -faasilised protsessid, mis väärivad sügava õppimise tagamiseks tähelepanu. Meeskonnatöö efektiivseks kasutamiseks on oluline rakendada sobivaid tehnikaid. Käesolev uurimistöö valgustabki neid aspekte, mis meeskonnatöös vajavad eraldi tähelepanu. Õpikeskkond, meeskonnatöö, ajakasutus, keerulised ülesanded ja probleemid ning nende koostoime välise maailmaga on õppimises paljude emotsioonide allikaks. Seetõttu on oluline, et seda teavet õpiprotsessis arvestataks. Emotsioonidel on õppimises tähtis roll, mistõttu on oluline mõista, kuidas kasutada emotsioonidega seonduvat infot sügavama õppimise toetamiseks nii

õppe kavandamisel, õpetamise-õppimise protsessis kui õppijate arengu hindamisel. Teisisõnu, uuringu tulemused aitavad parandada õpetamise praktikat. Samuti peab õpetajakoolituses olema tähelepanu keskpunktis teadmine, mis pedagoogiliselt on oluline ja mis aitab õppijat toetada.

Kokkuvõte

Toetudes uuringu tulemustele, võib väita, et inseneriõppe üliõpilaste õpikogemused ettevõtlusõppest varieerusid. Uurimistöö käigus tuvastatud kvalitatiivselt erinevad õpikogemused kannavad olulist teavet üliõpilaste õppimise kohta ning selle kohta, kuidas toetada üliõpilasi tähenduslikumal õppimisel, saavutamaks õpitust sügavamat arusaamist. Seetõttu saab uuringu andmeid kasutada nii õpetamispraktika parendamiseks kui sisendina õppejõudude koolitustel (eriti mittemajanduseriala õppejõudude ettevalmistamisel ettevõtlusõppeks). Samuti on oluline mõista, et käesoleva uuringu pedagoogilised järeldused ei piirdu ainult ettevõtlusharidusega, vaid on rakendatavad erinevates autentsetes õpikeskkondades, mis on seotud reaalsete eluliste (või simuleeritud) probleemide lahendamisega. Seega pakub sotsiaal-konstruktivistlikel põhimõtetel põhinev integratiivse pedagoogika mudel kasuliku raamistiku ja vahendid üldiste oskuste ning ettevõtlike hoiakute arendamiseks nii majandus- ja ettevõtlusõppekavades kui ka mittemajanduserialadel. Doktoritöö järelduste osas tuuakse välja võimalikud tulevaste uuringute suunad.

Võtmesõnad: ettevõtlusõpe, inseneriharidus, õpikontseptsioonid, õppimine (*learning, studying*), fenomenograafia, integratiivne pedagoogika (*integrative pedagogy*), emotsioonid, teema/temaatiline analüüs.

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Writing a PhD dissertation is like riding a roller coaster: there are some unexpected sharp turns as well as many ups and downs. However, it is worth the experience – feeling one's boundaries, expanding one's understanding about something particular, acquiring new ways of thinking, and starting to do things differently in contrast to earlier. One of the most valuable aspects of this roller coaster ride is that you undertake it with other people. In other words, the work of many people has influenced and helped me to see new aspects and issues related to my PhD studies. Some critical friends helped me just by questioning my views and others by sharing their own experiences and views. There were also some people who supported me during my PhD studies simply by believing in me and encouraging me every time I felt confused or stuck. Having said that, I would like to highlight some of these significant people who supported me throughout all the years during my doctoral studies, directly or indirectly, whether in a big or small way.

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PUBLICATIONS

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- Emotions and creativity in entrepreneurship education
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2005–2007	Eesti Post AS, turundusosakonna juhtaja
1986–2007	töötanud juhi abina, tootejuhina, projektijuhina, võtmekliendihaldurina (Saku Õlletehas AS, Reklaamiagentuur Inorek & Grey, jt.)

Uuringuvaldkonnad:

- Õppimine ja õpetamine (ettevõtlusharidus)
- Emotsioonid ja loovus ettevõtlusõppes
- Ettevõtlusmentorlus ja mentorlus

PUBLICATIONS

Täks, M., Tynjälä, P., & Kukemelk, H. (2015). Engineering students' conceptions of entrepreneurial learning as part of their education. *European Journal of Engineering Education,* (ETIS 1.1.), (Published online on February 14th), doi: 10.1080/03043797.2015.1012708

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3. **Hiie Asser.** Varajane osaline ja täielik keeleimmersioon Eesti muukeelse hariduse mudelitena. Tartu, 2003.
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